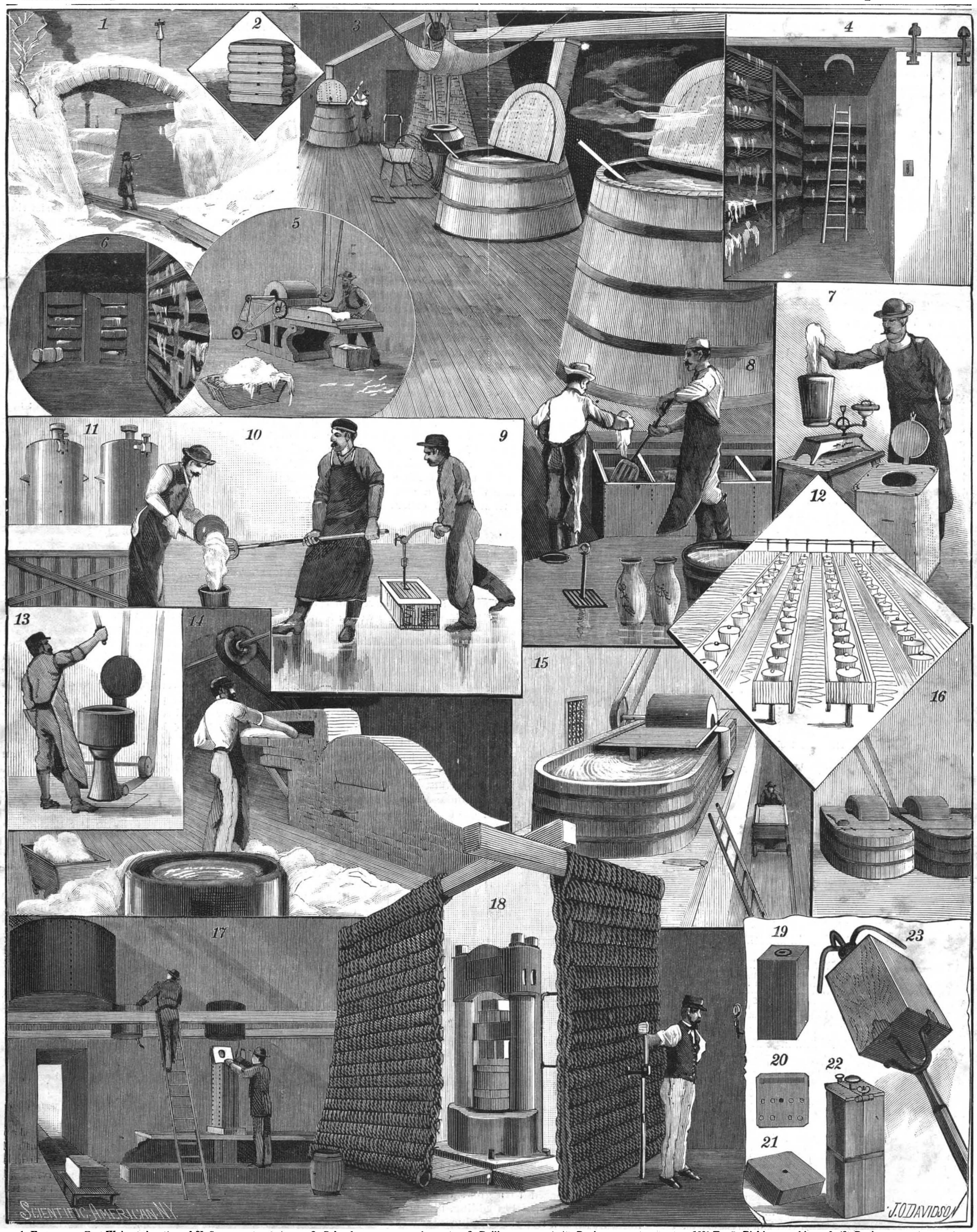
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyrighted, 1889, by Munn & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

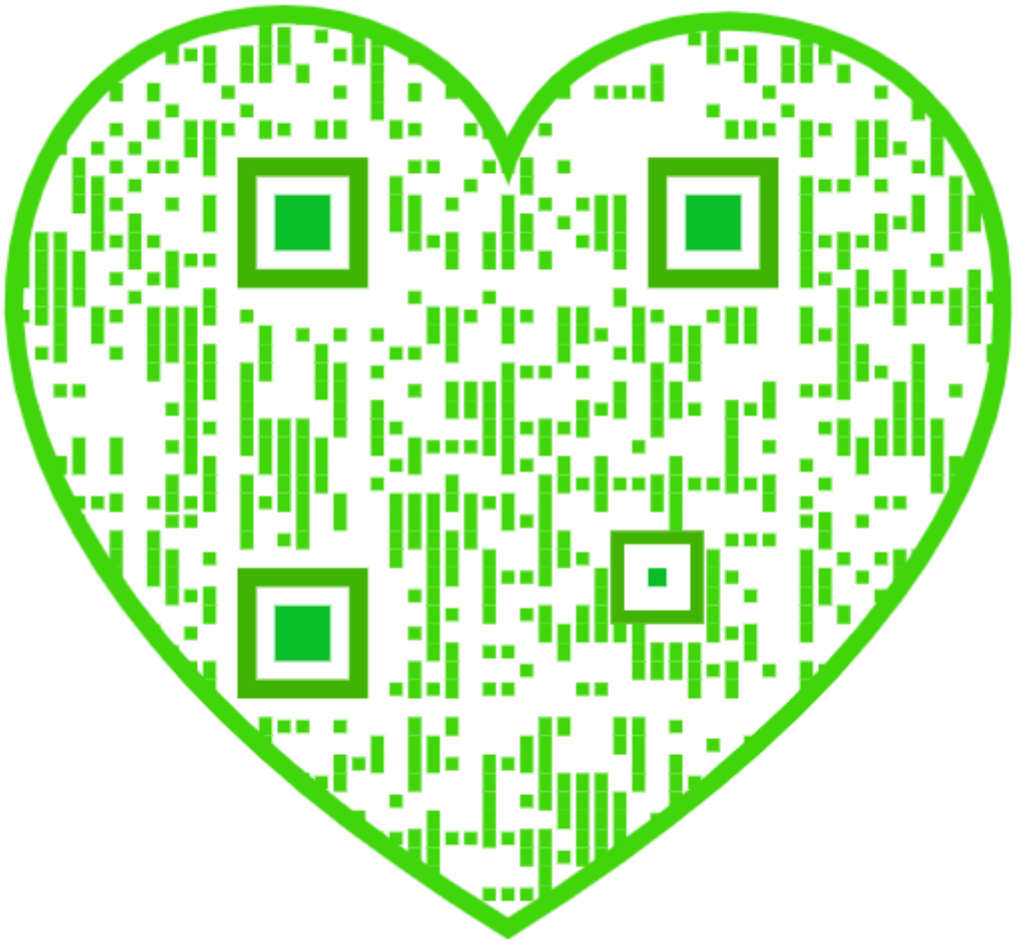
Vol. LX.—No. 8. ESTABLISHED 1845. | NEW YORK, FEBRUARY 23, 1889. | $3.00 A YEAR. WEEKLY.



1. Entrance to Fort Wolcott, location of U. S. gun cotton factory. 2. Bale of cop, or weaver's waste. 3. Boiling room. 4. (1) Drying room, temperature 180° F. 5. Picking machine. 6. (2) Drying room, temperature 225° F. 7. Weighing before "dipping." 8. Dipping in mixed acid—sulphuric (3) and nitric (1). 9. Pressing out mixed acid. 10. Potting in digesting pots. 11. Earthenware acid holders, or reservoirs. 12. Digesting pots in cooling troughs. 13. Centrifugal acid extractor. 14. Immersing tub and wringer. 15. Pulping machine. 16. Poachers. 17. Stuff chest and moulding machine. 18. Hydraulic press. 19. Gun cotton block moulded. 20 and 21. Gun cotton block compressed for service use. 22. Exercise torpedo. 23. Service torpedo.

UNITED STATES GUN COTTON FACTORY AT TORPEDO STATION, NEWPORT.—[See page 116.]

© 1889 SCIENTIFIC AMERICAN, INC



Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S. or Canada.....$3 00
One copy, six months, for the U. S. or Canada..... 1 50
One copy, one year, to any foreign country belonging to Postal Union, 4 00
Remit by postal or express money order.

Australia and New Zealand.—Those who desire to receive the SCIENTIFIC AMERICAN, for a little over one year, may remit £1 in current Colonial bank notes. Address

MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for U. S. and Canada. $6.00 a year to foreign countries belonging to the Postal Union. Single copies, 10 cents. Sold by all newsdealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, to any address in U. S. or Canada, on receipt of *seven dollars*.

The safest way to remit is by draft, postal order, express money order, or registered letter.

Australia and New Zealand.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for a little over one year on receipt of £2 current Colonial bank notes.

Address MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

NEW YORK, SATURDAY, FEBRUARY 23, 1889.

Contents.

(Illustrated articles are marked with an asterisk.)

Ache in the back..... 117
Alligators, disappearance of..... 113
Appliances, railway..... 122
Axle, Wilson's*..... 115
Balls, collision*..... 121
Business and personal..... 122
Canal, proposed, between Bristol and English Channels..... 120
Cars, refrigerator..... 115
Cigar makers, N. Y. City..... 113
Clevis for plows, Cole's*..... 115
Coasting without snow..... 121
Columns, short, weakness of..... 120
Council, good..... 117
Creolin in throat diseases..... 117
Elasticity of solid bodies*..... 121
Enquiries to be answered..... 123
Escape, fire, Berdrow & Pelkey's*115
Fever, scarlet, how distributed.. 115
Field, magnetic*..... 121
Foliage, planning of..... 120
Guard for ladders, Meisel's*..... 115
Gun cotton—its history, manufacture, use*.....111, 116
Gun cotton factory, Newport*... 111
Heater, steam, Sperl's*..... 114
Horse power, 18,000 or 20,000..... 120
Inventions, agricultural..... 122
Inventions, engineering..... 122
Inventions, index of..... 123
Inventions, mechanical..... 122
Inventions, miscellaneous..... 122
Iron, mountain of..... 117
Jerboa, the*..... 119
Lakes, great, formation of..... 117
Law, patent, English, changes in 121
Notes and queries..... 122
Ohm, George Simon..... 113
Overcoats..... 113
Paper from wood..... 115
Petroleum, Russian..... 115
Physics, simple experiments in*. 121
Piercer, ear, Greenough's*..... 114
Post office, hard work at..... 113
Railway, Faddis'*..... 115
Reply to N. Y. *World*..... 112
Report of Com. of Patents for 1888..... 112
Repulsion, electrical*..... 121
Rifle, automatic, new..... 117
Rifle, cast steel, test of*..... 118
Ryland, Mr., tragic fate of..... 113
Sewage disposal, terraced irrigation process*..... 119
Sharpener, tool, England's*..... 114
Shoe, brake, Diedel's*..... 114
Spark, electric, projection of*... 121
Steel, Henderson..... 121
Tigers, in Java, plague of..... 120
Tightener, wire, Reily's*..... 114
Trade mark infringement..... 120
Tramways in New York..... 114
Venus, the evening star..... 113
Water, sea, compressibility of... 121
Wheat in geranium stalk..... 117
Yorktown, official trial of..... 112

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 686.

For the Week Ending February 23, 1889.

Price 10 cents. For sale by all newsdealers.

PAGE

I. BIOGRAPHY.—N. M. Prjevalsky.—Biographical account of and review of the work of the eminent explorer of Asia..... 10963

II. BIOLOGY.—The Bald Headed Chimpanzee.—The probability of a second species of chimpanzee, with a description of a specimen in the Zoological Gardens of London.—1 illustration..... 10964

The Skeletons of the Museum Cetacea.—Mounting of whales' skeletons in the Jardin des Plantes, Paris.—The methods adopted and details of the iron framing.—1 illustration..... 10964

Yeast: Its Morphology and Culture.—By A. GORDON SALAMON.—Fourth lecture of this series, treating of germ culture.—6 illustrations..... 10960

III. BOTANY.—The Sweet Potato.—The cultivation and peculiarities of the sweet potato.—Its yield and flower..... 10966

IV. CHEMISTRY.—On the Use of Steam in Spectrum Analysis.—By JOHN TROWBRIDGE and W. C. SABINE.—An interesting modification in spectrum analysis, specially applicable to photographic work..... 10962

The Preparation of Phosphorescent Strontium and Calcium Sulphides.—By E. BECQUEREL.—Note on the preparation of different colored phosphorizing substances..... 10961

V. CIVIL ENGINEERING.—The Canadian Pacific Railway.—By THOMAS C. KEEFER.—The equipment and prospective traffic of the new road..... 10956

VI. ELECTRICITY.—Electrolysis of Melted Salts.—An interesting advance in electrical decomposition described and illustrated.—1 illustration..... 10957

VII. MECHANICAL ENGINEERING.—The Steam Engine—Its Principles, its Development, its Future, and Perfection.—By E. N. DICKERSON.—Interesting review of the conditions for development of the steam engine.—2 illustrations..... 10954

Triple Expansion Centrifugal Pumping Engine.—A four-cylinder triple expansion engine for use in Australian irrigation.—1 illustration..... 10952

VIII. MEDICINE.—The Action of Medicine.—By E. M. MCPHERON, M.D.—An attempt to determine the *modus operandi* of medicine to further rational application of drugs..... 10962

IX. MISCELLANEOUS.—Hairy People.—Remarkable instances of hirsute growth.—4 illustrations..... 10959

The Helmet of Philip II.—Illustration of the helmet of the old Spanish monarch.—1 illustration..... 10958

X. NAVAL ENGINEERING.—An Ice Ship at Mackinac, Michigan—A steamer with bow and stern screw specially designed for breaking through heavy ice.—1 illustration..... 10951

Steel Ferry Steamer for the Michigan Central.—A new transfer boat for the Michigan Central railroad.—1 illustration..... 10951

The Torpedo Boat Gymnotus.—The French submarine torpedo boat, with details of its trial at Toulon.—2 illustrations..... 10952

XI. PHOTOGRAPHY.—A Chapter for Amateurs.—By C. BRANGWIN BARNES.—Hints for amateur photographers by an expert..... 10957

The New Printing-out Platinum Process.—Details of manipulation of the new photographic process..... 10957

XII. TECHNOLOGY.—Flax Culture.—By H. MONIE, Jr.—An excellent description of the factory treatment of flax as conducted in Irish flax mills.—2 illustrations..... 10965

Fletcher's Compressed Oxygen Furnace.—A new apparatus by Fletcher, in which gas is burned mixed with air and oxygen.—1 illustration..... 10961

Laurel Nut Oil.—By DAVID HOOPER.—Chemical properties and commercial status and uses of this East Indian oil..... 10961

Manufacture of Sodium.—By C. NETTO.—A new attempt at manufacturing sodium cheaply by the reaction of powdered carbon.—1 illustration..... 10961

REPORT OF THE COMMISSIONER OF PATENTS FOR 1888.

The special report of the Commissioner of Patents to Congress, for the year 1888, has lately been presented, and is in many respects a very able and interesting document. The Commissioner, the Hon. Benton J. Hall, gives a very forcible statement of the existing condition of the Patent Office and the changes or reforms most urgently needed to improve the working and increase the utility of the bureau. It is a long document—equal to six of our pages—full of valuable suggestions and information.

The number of patents granted during the year 1888, including designs and reissues, was 20,506, being about one thousand less than for the year 1887, and nearly four thousand less than for the year 1885. The applications filed during 1888 were 37,797, and about the same number have been filed every year for six years. More rejections and fewer issues of patents appear to have been the order in 1888. The cash receipts of the office for 1888 were $1,118,576, and the expenses $973,108, leaving a surplus for the year over expenses of $145,407.

The Commissioner shows how seriously the business of the office is crippled for lack of sufficient room. He says:

"The various divisions of the Patent Office are crowded into narrow, inconvenient, and, in many instances, unhealthy limits. The records and drawings and other material, which should be conveniently arranged and made accessible in proper rooms, are stored in corridors and by-way places, where classification is almost impossible, and where access can only be had to the particular subjects desired after long search and delay. Not only this, but great quantities of valuable records, descriptions, specifications, and drawings are constantly exposed to the danger of conflagrations involving the safety of the entire building. It needs only an examination or investigation to demonstrate the absolute necessity that exists for making some change in the arrangement between the bureaus occupying this building, in order that each shall have proper room and facilities to discharge its respective functions. The force under the control of the Commissioner of Patents is scattered and located in remote parts of the building on different floors to such an extent that in order to communicate with the various divisions, transfer records back and forth, and conduct the business, much more time and a greater amount of labor are required than would otherwise be involved."

Of the *Official Gazette*, 6,500 copies are printed weekly, of which 2,265 copies are sold, and 4,235 given away to libraries, members of Congress, etc.

The Commissioner dwells upon a number of different subjects, all of greater or less importance. The difficulties of making official examinations of inventions are constantly increasing; but if more space were afforded, he thinks the present force of employes could do the work. He favors the protection of the inventor in the enjoyment of the exclusive right to his invention, but asks that the patent shall be dated from the time the patent was allowed and passed for issue, thus practically reducing the life of the patent.

The present law by which the term of the American patent is reduced to that of the term of the previously granted foreign patent he thinks should be repealed. He favors the allowance of caveat registration to foreigners; also a modification of the record law for assignments. The renewal of lapsed cases is found to be attended with complications, and a change is recommended. A modification of the law in the case of joint inventors is also proposed. The Commissioner defends the present system of official examination of inventions, but at same time indicates that it is full of serious difficulties. He shows the hardships of interference proceedings, and offers suggestions for a partial remedy. He points out some of the absurdities and difficulties attending the international union respecting trade marks and patent properties. He thinks the examiners should have an increased compensation. Attention is also called to the importance of perfecting and finishing the abridgment of patents.

The total number of patents granted since the organization of the United States government is 405,262.

A REPLY TO THE NEW YORK "WORLD."

Principal Examiner W. W. Townsend has recently published in pamphlet form an able and scathing reply to the recent attacks of the New York *World* upon the good name and fame of the Patent Office. We regret the limits of our space prevent us from giving Examiner Townsend's essay in full. It would occupy almost two of our pages. We are obliged to content ourselves with an extract from the concluding portion, which will convey some idea of the author's views and the vigorous, clear style in which he presents them:

"The inventive genius of the country may, in truth, be aptly compared to a great tree, deep rooted in a genial clime, constantly budding, blooming, and fruiting. But it is a tree that produces both good and bad fruit; and oftentimes a great deal of husk covers a very small kernel, scarcely worth the saving.

"The Patent Office is the great winnowing machine, through whose operation vast masses of rubbish which would otherwise obstruct the industries of the nation are consigned to the waste heap. To abolish the official search would be to destroy this machine, and substitute what? A host of similar machines, badly made, unfinished, and left to run themselves at enormously increased aggregate expense. Do away with the system of official examination, and you are more likely to practically legalize a species of robbery now but rarely practiced, and only upon the easily duped, rather than to effect an improvement such as would warrant such an extreme measure.

"It is admitted that the present system has many defects. But they are not inherent in the system itself; they are rather the result of the manner in which the system is administered, and largely of the disposition to consider public office as spoils of war and not as a public trust; of the niggardly policy which allows upward of three millions of dollars to lie idle in the Treasury to the credit of the Patent Office, while the salary of the Commissioner is at such a figure that in the last thirty-eight years there have been nineteen incumbents of the office. Experience has developed defects in the details of the law; but Congress utterly ignores the Commissioner's oft-repeated recommendation as to the cure.

"But what is the remedy? The inventors of the country have it in their own hands. Let them insist that the office shall have ample means, ample room, ample force, so that there shall be an end of inaccessible records and extra hours of labor, with their demoralizing tendency to lax and hasty work. Let them insist upon having a commissioner and assistant commissioner trained in science as well as in the law, and with such a salary as will insure their incumbency for a reasonable period, and consequently a much needed stability in the practice of the office. Let them insist upon an examining force selected and tested and promoted by rigid competitive examination and not by political influence, as has too frequently been the case. Let the organized inventors insist upon these things, and they will get them; and having got them, I will undertake to say that the business of granting patents will be carried on with as little friction and individual hardship as necessarily accompany the administration of any great public function. But without the requisites named, inventors will continue, as now, to suffer occasional hardship, while as a class obtaining substantial justice and protection, and the public will continue sometimes to be robbed in the name of the law through the wrongful issuance of patents."

OFFICIAL TRIAL OP THE GUNBOAT YORKTOWN.

The gunboat Yorktown was subjected to an official trial on Wednesday, February 13, to determine her acceptance or rejection by the government. The trial as far as reported was a complete success, the contract requirements of speed and horse power being exceeded. Four hundred tons of pig lead were distributed through the ship so as to represent her stores, guns, and other equipments. Thus seventy-two tons of lead was placed in six piles at the positions to be occupied by the guns. This weight brought her down to draught in fresh water of 13 ft. 4 in. forward and 15 ft. 4 in. aft—a mean draught of 14 ft. 4 in., with a displacement of 1,703 tons. The day before the trial she ran down the bay and anchored inside the breakwater. Early the next morning preparations were made for the trial. This was to be a four hours' run. The run over the measured mile has been discarded as a satisfactory test, as the speed thus shown is fallacious, in the sense that it may be largely in excess of that which can be maintained for any length of time. Three to five minutes is not sufficient time in which to prove a vessel's capabilities.

The Yorktown ran out to sea, and at 9:45 A. M. the official test began. Quite a heavy breeze was blowing, with considerable sea. The chip log and taffrail log were kept in use continually, and a large corps of government inspectors took indicator diagrams from her different cylinders, so as to obtain full data for speed and developed horse power.

The ship started nearly southeast, with the wind abeam, her speed increasing quickly from 16·7 to 17·2 knots per hour. After an hour's run the ship was turned so as to bring the wind on one bow, and the speed dropped off to 15·3–15·9 knots. The wind was next brought dead ahead, when a speed of 14·9 was shown. The four hours' run ended where it began, off Cape Henlopen. The steam pressure varied from 145 to 168 lb. In all the four hours' work no journal became heated.

The chip log, used at 15 minute intervals, showed an average of 15·67 knots, and the average of two taffrail logs was almost exactly 16 knots. Every 15 minutes twelve different indicator cards were taken, giving 192 to be calculated. The indicators are first to be tested for accuracy, and it is probable that the slower of the two taffrail logs will need a correction in favor of the ship. The results of the trial are, therefore, not yet definitely known; but it is thought that they will show about 3,550 horse power and over 16 knots speed.

© 1889 SCIENTIFIC AMERICAN, INC

This will give the contractors a bonus of upward of $50,000. The consumption of coal was about 120 tons a day under forced draught and at high speed. For a 10 knot speed it is about 30 tons a day.

Evolution was next tested, and it was found that a little over five minutes was needed for a full turn, whether by running her engines in opposite directions or by the rudder only. The diameter of the smallest circle was estimated at from 150 to 200 yards. Nothing was gained by reversing one engine. The full speed could be checked and the ship brought to a dead stop in 1 m. 1 s., in about 200 yards. Taking the warships and merchant vessels together, it is estimated that the Yorktown could overtake 95 per cent of them.

Overcoats.

The teaching of modern science and of ancient custom goes to show that heat production within the body has much to do with the tissue changes concerned in muscular activity and with healthy digestion. It is conserved by warm and moderate, wasted in evaporation by excessive, clothing. Finally, by a simple nervous reaction, it is increased after the contact of external cold. It follows from these observations that, if we be so clad with comfortable underclothing that surface perspiration is not formed in excess and is rapidly removed, one great cause of chill—sudden evaporation—is done away with. Outer cold, then, provided it is not too severe, only touches, as it were, the spring of the heat-making metabolism, and, exciting an elastic rebound in the chain of vaso-motor fibers, awakens that oxidative action by which every tissue is made to yield its share of heat to the body. This bracing influence is lost wholly or partly to those who are too heavily clothed, and in its place we may have a dangerous excess of surface heat. It is for this reason that we have before protested, as we now do, against the indiscriminate use of the thick and heavy overcoat. We would rather see men in fairly robust condition, especially if young, clad warmly next the skin, and wearing either a light top coat or none at all. There can be no doubt that the habitual use of great-coats is indirectly accountable for the chills which they are intended to prevent. Were the overcoat worn continuously, it might attain its object. Its intermittent use, even when ample underclothing is worn, affords no solid guarantee of safety, but rather the reverse. The man of sedentary habits has especial need to remember this. He emerges daily from a warm breakfast room clothed in his ordinary winter garments, with probably woolen underwear, and over all the heavy ulster or top coat. After a short walk he finds that the sense of warmth he began with is more than maintained. He arrives at his office or place of business, and off goes the overcoat, though the air of the newly opened room is as cold as that without, and draughty in addition. During the day perhaps he travels to and from adjacent business houses wearing only his house clothing. The overcoat is laid aside till closing time reminds him of the journey home. The frequent result is that somehow, between the hours of his departure and return, he is chilled. No doubt he would run as great a risk if, lightly clad, he were to face the rigor of a winter day. In this case, however, exercise and habit might do much to develop the power of endurance, and there would, at all events, be less danger of sudden cold acting upon a freely perspiring surface. Woolen underclothing represents a state of healthy comfort intermediate between these extremes, and more resistant to chill than either. In commending its use, however, we do not assert that the influence of age and constitution is to be overlooked. Youth can oppose a power of resistance to depressing agencies which does not reside in the worn-out nerve centers of a riper age. Similarly, that elastic reaction which characterizes the nervous and sanguine types is not to be looked for in the lax tissues of the lymphatic. The weaker physique naturally calls for fuller protection than the stronger; and any rule requiring the disuse of the overcoat should allow of reasonable exceptions in favor of the old and constitutionally feeble. Unusual severity of weather, especially if associated with night air and the loss of sleep which this implies, is another condition which might well constitute an exception. In such a case we are compelled to add some form of overcoat to the ordinary amount of clothing. Some parts of the body—for example, the chest, throat, and feet—are certainly more susceptible to cold than others. As a useful safeguard, cold or tepid bathing of such parts is in merited favor. The custom so common with many persons, especially women, of walking out in thin-soled boots often plays an important part in catching cold. The progress of time and of rational thought may be expected to bring in a more comfortable arrangement by clothing the foot in woolen hosiery and a stouter boot.—*Lancet.*

THE alligator of the South, like the buffalo of the West, is likely soon to become extinct. The slaughter of the alligator for its hide, like the slaughter of buffaloes for their hides, has been so great that it will be only a few years before the lonely lagoon of Florida will have lost its last survivor.

New York Cigar Makers.

Over 30,000 men, women, and children are employed in the tobacco industry of this city, of whom about 16,000 are cigar makers proper, the rest being cigarette makers, strippers, bunchers, packers, pasters, box makers. More than 6,000 cigar makers are women, girls, and small children. Some branches of the trade are almost monopolized by girls. For instance, the making of cigarettes. The nationalities which predominate among the cigar makers are the Germans, Bohemians, and the English, but there are also quite a number of Poles, Hollanders, Cubans, and Hungarians, with a sprinkling of Spaniards, Americans, French, and Russians.

The best cigar makers are the Germans and Bohemians; the Cubans and Spaniards rank next. The Poles are ruining the trade here by cheap work done in basements in Division Street and its neighborhood. They work, as it is termed, "below zero," just as the Chinese are doing in San Francisco. The Cubans and Spaniards make a special grade of goods called "Spanish work." Cigar making has of late years become so unprofitable to the working people that the average weekly wage ranges only from $6 to $7. Even the best workers, making cigars by hand, average only $15 per week if working full time all the year round on first class material, but this fortunate class comprises hardly fifteen per cent of all cigar makers. The poorest class of workers average only $5.50 per week, and therefore their wives and children must help by their work to swell the income of the family. The working time is about eight hours a day—a result of their strong organization.

Eleven manufacturing firms own tenements in this city in which they house their workers under the so-called tenement house cigar making system. These mean firms keep the tenement horror alive by employing 546 entire families. Counting at the lowest estimate five working members to each family would give us the correct number of tenement house cigar makers, viz., 2,830. Each family has either two or three rooms, small, poorly ventilated, and dark. In these accommodations they have to pay $3 more for their monthly rent than they would if they were allowed to live where they liked. But—and here the fine game of the cigar manufacturing landlord comes in—no rooms, no work. So these poor people have only the alternative to accept low wages, high rent, and long hours of work (fourteen hours daily on an average) or walk the streets and starve. In these houses, which cannot be called homes, one finds the greatest filth, misery, and degradation imaginable.

To sensitive persons a description of the horrors would be insupportable. It is happily true that "one-half the world does not know how the other half lives." Cannot these conditions be amended or abolished? For years the cigar makers have banded together in unions to suppress this terrible, inhuman system. Some headway they have made in their endeavors—for which they have been called conspirators and revolutionists. If American workmen were obliged to live in this manner, they would have been revolutionists long ago.

There are 1,800 cigar factories in New York City. Of these the great majority employ from one to fifty hands each. Large factories, of which there are 350, employ from 50 to 500 hands, while the largest class of factories, of which there are only ten, employ from 500 to 1,000 hands. The vital statistics gathered in the course of years by some organizations show that among the cigar makers lung troubles are of common occurrence. Women must frequently stop work to recuperate from the bad effects tobacco has upon them.

There is another danger which threatens the cigar makers and promises to thin the ranks already thinned by competition among themselves. Last year bunching machines threw 400 persons out of work. Yet cigar making machinery is only in its infancy. In the opinion of many cigar makers, the trade is leaving New York City, and will never be as good and prosperous as it was in past years. New York is fast losing its former prestige by manufacturing cheap cigars in too great quantities.

Since 1864 the cigar makers have made determined efforts to organize themselves and, through organization, to better their condition. They have succeeded in accomplishing a great amount of good to their craft. The Cigar Makers' International Union of America has been in existence for thirty-five years. The number of its members is very large and probably exceeds 25,000. Of the cigar makers in this city about 8,000 are organized. They stick to their organizations faithfully and are among the best, most intelligent, and most energetic working men.

Since 1879 the International Union has paid out for strike benefits $369,833, for sick benefits $182,425, for death benefits $21,843, and for traveling benefits $196,882. The present fund in its treasury amounts to over $253,000. The powerful agitation for the suppression of the tenement house system has resulted in greatly mitigating that evil. Their union label is an effective weapon against unfair employers, and has brought many of them to terms. At present it is used by 386 manufacturers in this city alone, who have to observe certain rules of the union for the privilege of using it. Manufacturers who sell tenement-made goods are debarred from its use.—*The Metropolis.*

George Simon Ohm.

In view of the near approach of the hundredth anniversary of the birth of George Simon Ohm, which took place on March 16, 1789, a meeting was held recently in the meeting room of the Royal Society, London, under the presidency of the Right Hon. Lord Rayleigh, secretary of the Royal Society, for the purpose of appointing a committee to co-operate with the committee formed in Germany to promote the erection in Munich of a statue of the great physicist, to whom the science of acoustics owes no less than does that of electricity. In the course of the meeting the following gentlemen were selected to act on the English committee: Sir F. Abel, D'Atkinson, Mr. Vernon Boys, Mr. Conrad Cooke, Professors Ewing, Fitzgerald, Fleming, G. Carey Foster, Mr. Glazebrook, Professor D. E. Hughes, Mr. Norman Lockyer, Professors Hugo Muller, John Perry, Mr. W. H. Preece, Lord Rayleigh, Professors Reinold Rucker, Stokes (president of the Royal Society), Mr. Swinburne, Sir William Thomson, and Professor S. P. Thompson. Lord Rayleigh was elected president; Professor Hugo Muller, treasurer; and Professor G. Carey Foster, of University College, London, and Professor John Perry, of the Finsbury Technical College, undertook to perform the duties of secretaries, and to receive subscriptions.

Tragic Fate of Mr. Ryland.

An accident lately occurred at Hawkesbury Bridge, Sydney, New South Wales. Mr. Ryland, of Messrs. Ryland & Morse, of New York, sub-contractors for the erection of the superstructure of this great bridge, was walking along the top of one of the spans when he missed his footing and fell some fifty feet into the river below. Even as he was falling a huge shark was observed immediately below, and the unfortunate man had scarcely reached the water when the monster seized him, and both disappeared under the water, which at once became tinged with blood. A number of workmen and others on the bridge who witnessed the accident remained horror-stricken and helpless. The deceased, with his partner, was just bringing to a successful close a contract of considerable magnitude. The Hawkesbury Bridge, it will be remembered, was built by the Union Bridge Company, of New York. Messrs. Anderson & Barr, of this city, were sub-contractors for the piers.

Hard Work at the Post Office.

Some idea of the vast amount of matter which passes through the New York City post office may be gained from the following statistics:

Last year there were 128,131,755 letters, 32,310,025 postal cards, and 35,943,203 miscellaneous packages delivered during the year by carriers, and 52,994,536 letters, 8,519,869 postal cards, and 30,995,086 miscellaneous packages through boxes, making a total of 287,994,464 pieces in all. In the registered letter department, there were 1,317,168 pieces delivered, and 1,049,029 pieces of domestic and 453,850 of foreign origin recorded and distributed to other offices. At the general post office, 1,095,915 money orders were issued and paid, amounting to $10,230,895.50, and 783,872 postal notes, amounting to $1,263,378.79. At the sixteen branches the number of orders issued and paid was 220,144, amounting to $3,250,961.10, and the number of postal notes 88,311, amounting to $174,476.66. The aggregate business of the money order department for the year amounted to $87,299,158.95, giving an increase in the business over the previous year of $4,788,347.21. The total receipts of the office were $5,162,968 81, and the total expenditures $1,891,982.48 (including $802,017.91 expended for free delivery service), giving a net revenue of $3,270,986.33. The receipts for the last quarter of the year aggregated $1,458,585.27, an increase of $121,034.65 over the receipts of the corresponding quarter of the previous year. There were sold during the year 178,218,226 postage stamps, equal in weight to thirteen tons net, 35,302,500 government stamped envelopes, and 46,437,150 postal cards. The total weight of mails received and dispatched daily during 1888 was 248 tons.

Venus, the Evening Star.

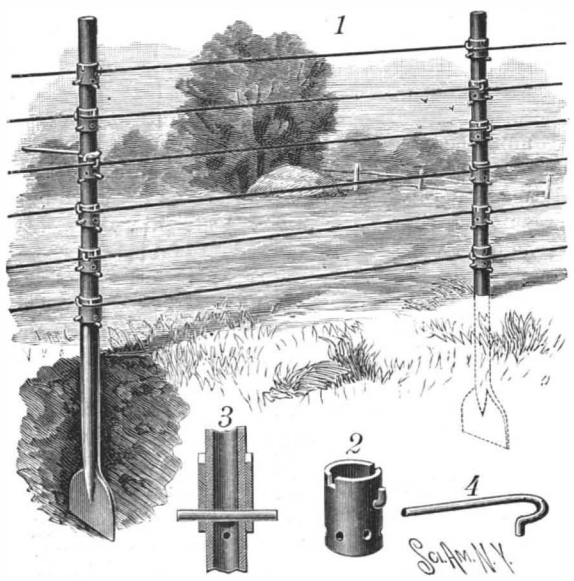
Mr. Walter H. Smith, President of the Astro-Meteorological Association, Montreal, has been making special observations on the planet Venus with the aid of a reflecting telescope, and reports rapid changes in the shape and outlines of the horns, due to the planet's rotation bringing mountain ranges to the edge of the disk.

A peculiar indentation has been seen at the north horn, similar to observations made by De Vico, Pastorf, and other astronomers. Three spots, believed to be continents, and similar to those seen at the Roman College in Italy, were also noticed. Mr. Smith is the founder of the society, and is well known as a careful observer.

© 1889 SCIENTIFIC AMERICAN, INC

AN IMPROVED WIRE TIGHTENER.

The illustration herewith represents an invention patented by Mr. Thomas Reily, of Blencoe, Iowa. The post for fences with which such device is used preferably consists of a metal tube having a spade-like lower end, whereby it may be readily driven into the ground and will be held from turning. The post has a series

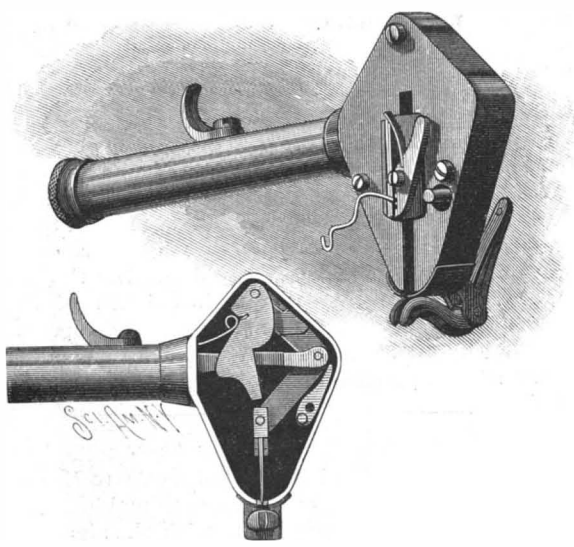


REILY'S WIRE TIGHTENER.

of diametrically opposite apertures, as shown in Fig. 3, one aperture for each strand of wire to be used in the fence, and just above these apertures are similar ones at right angles thereto. Collars or sleeves, as shown in Fig. 2, are adapted to be slipped over the post, and held to turn loosely thereon by pins passed under them through the apertures in the post. In the lower ends of these sleeves are apertures adapted to register with one of the series of apertures in the post, whereby the sleeves can be turned around on the post and held in desired position by pins passed through the sleeve and the post. The sleeve has an upwardly extending arm, adapted to engage and support a fence wire, and in the upper end of the sleeve are vertical slots, to engage the lip of a wrench shown in Fig. 4. After the strands of wire have been secured to the end posts, the wire passing from post to post in contact with the sleeves, and in engagement with the upwardly extending projections, the wrench is inserted in one of the slots of the sleeve and turned in the direction in which the wire is to be tightened, the sleeve being held in fixed position, after the wire has been drawn sufficiently taut, by passing a pin through one of the apertures therein and a corresponding registering aperture of the post.

A DEVICE FOR PIERCING EARS AND INSERTING EARRINGS.

The illustration herewith represents an ear-piercer, patented by Mr. John J. Greenough, by which the needle is instantly projected through the ear and retracted, the needle also carrying the wire of an earring to remain lodged in the incision, the hole being bored, the earring inserted, and the needle withdrawn at a single instantaneous operation. The ear is held while being pierced by a spring lip on the bottom of the device, adapted to lightly embrace the lobe of the ear. The needle slide is attached to a toggle joint, the upper end of which is jointed to the case, as shown in the section-



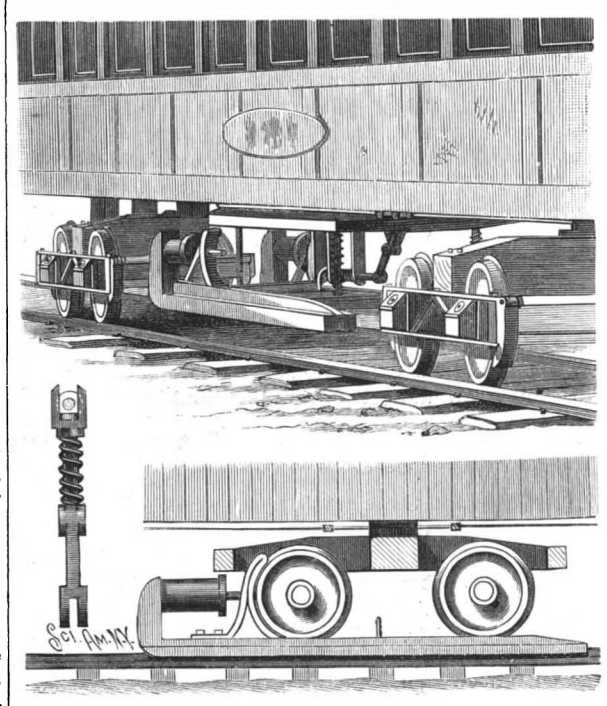
GREENOUGH'S EAR PIERCER.

al view, the center joint of the toggle being coupled with a slide rod extending into a hollow handle, where it is surrounded by a spiral spring. A collar on the rod has a stud working in a slot in the handle, there being a notch to engage the stud and hold the slide rod back with the spring compressed. Then, on releasing the stud, the slide-rod in moving forward forces the toggle joint past its center to the same distance on the other side, moving the needle-slide forward and back by the single impulse of the spring. Directly over the piercer is a slot through the cover, in which slides a forceps block carried by the needle slide, this block having a groove in which the wire of the earring is held, by a movable eccentric jaw, against a corresponding groove in the needle, this forceps block pressing the wire of the earring into the groove of the needle only during the downward motion of the latter, so that the needle retreats without drawing back the wire.

For further information relative to this invention address Mr. George W. Langdon, Clinton, Mass.

AN IMPROVED BRAKE SHOE FOR RAILROAD CARS.

A brake shoe, adapted to be carried beneath the cars of a train, all of the shoes being capable of being brought into simultaneous action, whereby the cars may be expeditiously stopped from the engine cab, is illustrated herewith, and has been patented by Mr. Gustav A. Diedel, of No. 375 Third Avenue, New York City. This brake is principally designed for use in case of emergency, on trains carrying other brakes, as an auxiliary means of suddenly stopping the cars. A rectangular turntable is pivoted centrally beneath the car, and held in position by a bolt passing through the car floor and into a recess in the upper face of the turntable, the bolt being normally locked by a spring. About the center of the under side of the table is a hanger, in the posts of which a horizontal releasing bar is held to slide, to the outer end of which is pivoted a trip lever, shown in detail in the small view. This lever is fulcrumed upon a bracket, the upper end of the lever being curved to one side and carried upward through and beyond the turntable. The trip lever is manipulated by a rod, chain, or wire rope, sliding be-



DIEDEL'S BRAKE SHOE.

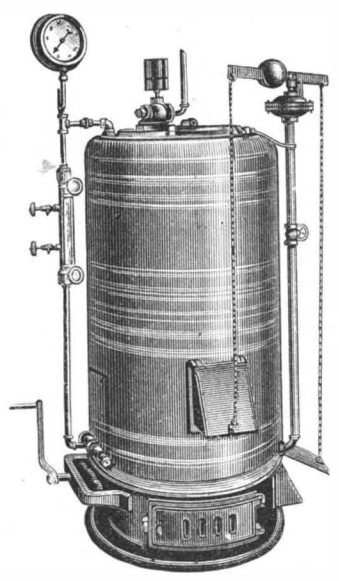
neath the car body, and with a suitable lever within or adjacent to the engine cab, similar connections being made with all the different brake shoes employed on the same train. The brake shoe consists of two side bars, spaced to the width of the track rails by cross bars, each side bar having a track formed longitudinally on its upper surface, while its lower side is adapted to fit snugly over the rail head. The side bars are also connected by a cross beam, from which a head block is projected, with a horizontal air cylinder attached, with a small vent and piston head and rod, the outer end of the rod being carried through and held to slide in buffers attached to the side bars, so that when the truck wheels ride upon the shoe track, an effective air cushion will thus be formed. When the shoe is attached to the turntable, it is manipulated to bring the buffer end in the direction of the forward end of the car, this being done by lifting the bolt through the car floor and revolving the turntable, the trip lever being then disengaged from the draw rod. To stop the train, the engineer pulls the cab lever, which withdraws the releasing bar from the hook or staple of the shoe, in each shoe in use on the train, the shoes then dropping and remaining saddled upon the rails.

Street Tramways in New York.

During the year ending September 30, 1888, the number of passengers on the street railways and elevated railways of New York City was 376,913,586, an increase of 18,000,000 over the number for 1887. This, at the uniform fare of five cents, represents a total revenue of $18,845,679.30. There are nineteen "city railway" companies, eighteen of which are horse car surface lines, and the other is the elevated railway system, with its four parallel lines. The equipment consists of 3,054 cars and 13,586 horses. The elevated lines have 921 cars and 291 locomotives. The number of employes is 11,725.

AN IMPROVED STEAM HEATER.

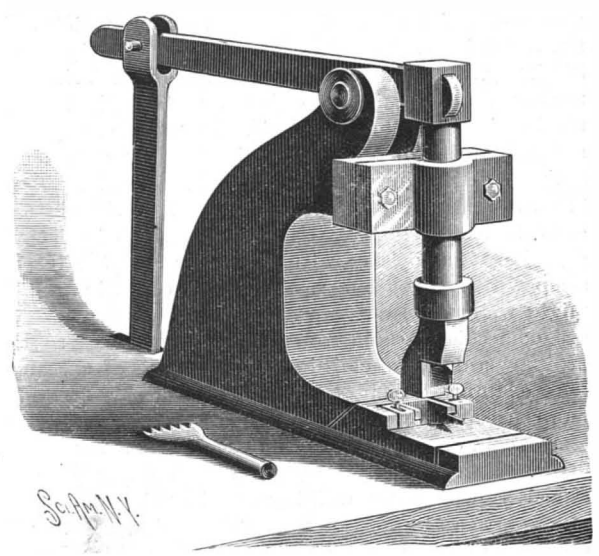
A heater designed to make steam quickly, and maintain a high degree of heat with a comparatively small quantity of fuel, is illustrated herewith, and has been patented by Mr. Henry Sperl, of Susquehanna, Pa. This heater is made with a tubular base ring and a tubular crown ring, these rings being connected by a circular series of vertical pipes, each of which has on its inner side a rod, the ends of the rods passing through openings in the top and bottom rings, where they are secured by a rod and firmly hold the several parts of the heater in position. Above the base and between the pipes a ring-shaped reservoir is mounted, having a central opening and flues arranged in a circle, short horizontal pipes connecting some of the vertical pipes with the reservoir, while another pipe connects the reservoir with one of the vertical tubes at its upper end. The heater has an outer and an inner jacket, each having an opening for the reception of a damper box, and the outer jacket also has an opening for the admission of a water induction pipe, and another for a discharge pipe, each pipe communicating with the tubular base ring. The furnace fire quickly heats the water in the central reservoir, setting up a circulation through the series of pipes and the base and crown rings, and rapidly generating steam, the products of combustion passing upward around the pipes, thence over the top of the inner jacket, and downward between the jackets to the discharge flue near the base, several dampers being provided for the easy regulation of the draught.



SPERL'S STEAM HEATER.

A DEVICE FOR SHARPENING STONE-CUTTING TOOLS.

The accompanying illustration represents a simple mechanism for sharpening tooth chisels, tooth axes, etc., and for gumming saws and punching holes in metals. It has been patented by Mr. Edward England, of No. 16 Buchanan Street, Duluth, Minn. A cutter or punch is held in a shank or chuck fastened to an upright shaft operated through a compound lever by the foot or other mechanical power. A throat plate is firmly secured to the under jaw of the device, forming a guide to the shank through a throat, the guide being secured to the ledge of the throat plate by a thumb screw to move in and out from the ledge and regulate the length of the teeth. A gauge is also secured to the ledge of the throat plate by a thumb screw, and can be moved from right to left or left to right to regulate the width of the teeth. The proper size cutter or punch having been fixed in the chuck, and the guide and gauge adjusted, the edge of the chisel or other instrument to be sharpened is heated red hot and held against the ledge of the throat plate, when the lever is pressed down by the



ENGLAND'S TOOL SHARPENER.

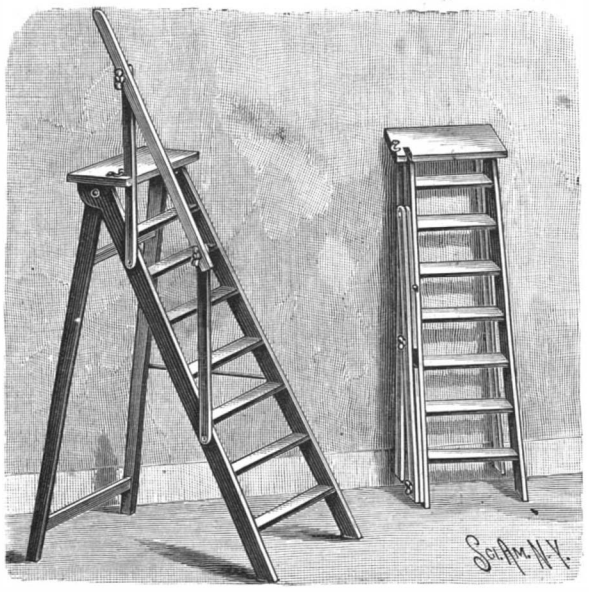
foot of the operator, the operation being repeated as often as required.

The *Electrical Review* suggests that our city authorities should put danger signals over all electrical subway manholes. Then when the unwary passer-by is hurled against Trinity Church spire, he or his heirs won't have so strong a suit for damages.

© 1889 SCIENTIFIC AMERICAN, INC

AN IMPROVED GUARD FOR STEP LADDERS.

A step ladder having foldably attached thereto a hand-rail guard, to give greater safety in its use, is illustrated herewith, and has been patented by Mr. Otto J. Meisel, 129 Ohio St., Terre Haute, Ind. The top step has a notch or recess in its edge, in which an arm pivoted to the side-piece of the ladder is adapted to enter when

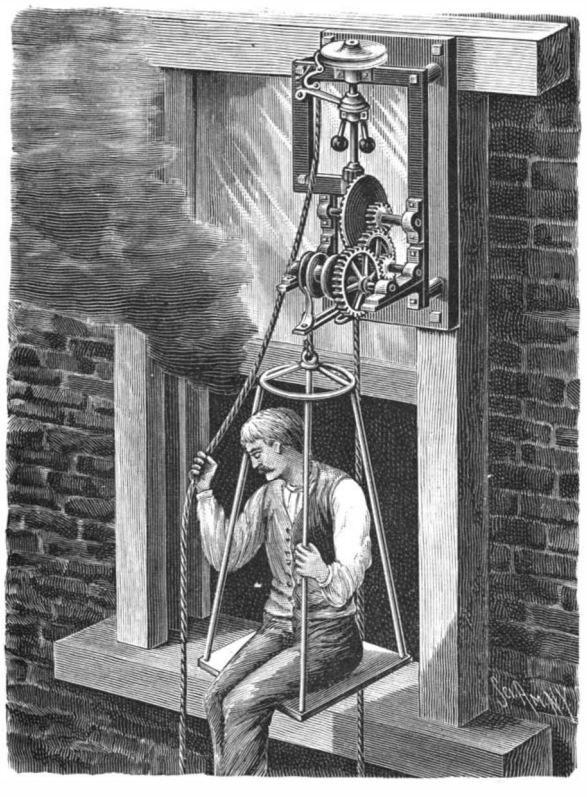


MEISEL'S GUARD FOR STEP LADDERS.

the hand-rail is to be used. There are two of these arms pivoted to the upright, the outer ends of the arms being connected by thumb-screws to the guard rail, and in the upper arm is a staple with which a hook on the top step is engaged to hold the hand-rail and arms in position when the top arm is entered in the notch. To fold the hand-rail it is only necessary to loosen the thumb-screws and disengage the hook, when the arms can be turned down to the position shown in one of the views, the thumb-screws being then tightened again to hold the arms and guard folded.

AN IMPROVED FIRE ESCAPE.

A device designed to facilitate escape from a burning building is illustrated herewith, and has been patented by Messrs. James G. Berdrow and Frank A. Pelkey, of Seward, Neb. It has a frameadapted to be rigidly secured to the outside of a door or window casing, the frame having near its bottom forward projecting bearings in which is mounted to turn a transverse shaft having fixed thereto a pair of grooved winding drums. Hoisting cables are wound in opposite directions on the drums, the cables having hooks on their lower ends for attachment to suitable cars or cages, so that when one car descends, the other cable will be automatically wound up, bringing up its attached car for use by the next person. On the winding shaft is a cog wheel gearing with a pinion on an inner shaft, the latter also gearing with another shaft carrying a bevel gear communicating motion to a vertical shaft, the



BERDROW & PELKEY'S FIRE ESCAPE.

multiplying of the gearing causing the vertical shaft to revolve rapidly while the winding shaft is rotating comparatively slow. On the upper end of the vertical shaft is a brake wheel, the brake shoe of which is adapted to be operated by an angle lever, to check the speed of the winding shaft, a hand rope from the outer arm of the lever passing through a stationary guide down to where it can be conveniently grasped and drawn upon by the person descending in the car. An automatic governor device is also fixed on the vertical shaft, whereby any excessive speed of the descending car will cause the brake to be applied without the use of the hand rope.

Refrigerator Cars.

The refrigerator cars in which meat is brought from Western stock yards to Eastern markets are 29 feet long inside, 8 feet 2 inches wide inside, and 7 feet 2 inches from the floor to the cross beams to which the hooks are fastened, above which is a space of 14 inches to the roof. At each end are galvanized iron tanks filled with a mixture of pounded ice and coarse salt. The temperature of the cooling rooms and the cars is kept as nearly equal as possible, about 30° to 36°. Between the cooling room and the car shed is the shipping room, where the beef that is to be shipped is weighed, quartered, and rigidly inspected. When loaded, a car contains about thirty carcasses, averaging 650 pounds. All the hind quarters are hung in one end of the car, and the fore quarters in the other. The cars are iced the day before shipping, refilled just before loading, and are iced again every twenty-four hours at regular stations on the route. Experiments have proved that in this way beef can be kept sweet for two or three weeks, and will taste quite as well at the end of that time as meat killed and eaten within two or three days. When the cars return empty, they are side-tracked at the packing house, and undergo a thorough scrubbing and cleaning with boiling water, the hooks are washed and polished, and the car is allowed to stand for twenty-four hours with open doors before it is again loaded for the Eastern market. The amount of traffic with the meat trains is something enormous.

AN IMPROVED AXLE.

The accompanying illustration represents an axle so constructed that, if one section should break, it may be detached from the other and a new section put in place, thus obviating the necessity of losing the whole axle. It has been patented by Mr. Charles H. Wilson, of No. 17 Beacon Avenue, Jersey City Heights, N. J.

WILSON'S AXLE.

The axle is made in two sections, each having their inner ends externally screw-threaded, one section having a reduced screw-threaded portion or shank and the other section having an internally screw-threaded cavity to receive this shank. The outer surfaces of the central portions of the two sections are screw-threaded, and upon them is screwed a coupling sleeve or tube, which is held in place by a collar and set screw on each end.

Russian Petroleum.

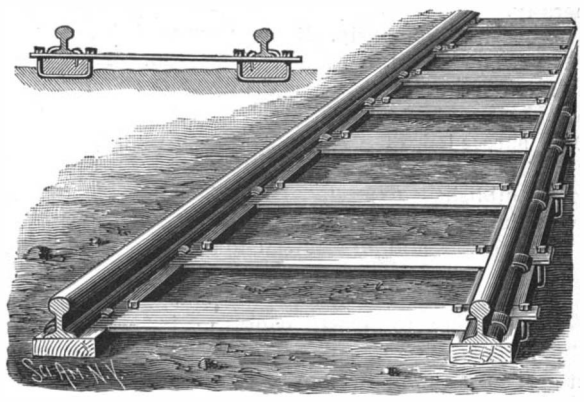
M. De Tchihatchef, a Russian writer, asserts that the average flow of petroleum in the Baku region is 88,000 barrels per day, as against 25,300 barrels in the United States. The chief drawbacks encountered by those who have worked the Baku oil fields have been lack of transportation and want of cheap package. A railway to Batoum, on the Black Sea, opened two maritime routes to Europe, and met the first difficulty. Cars and vessels constructed to carry crude oil met the last, and enabled refineries to be built in the interior of the empire wherever fuel might be cheapest. It is confidently predicted, since the completion of the Batoum Railway, that Russian oil will displace American in European markets, and that it will even be possible for the Russian product to compete for the markets of the United States. M. De Tchihatchef points out a probable demand in the near future for petroleum to serve as fuel on the great lines of railway completed and still building in Asia.

How Scarlet Fever Poison is Distributed.

The *Medical Era* relates the case of a girl aged about eight, living at Fortress Monroe, Va., who was some months ago attacked by scarlet fever, the disease running a typical course. For a long time no possible source of contagion could be discovered. The child had not been absent from home, had been with no one lately exposed, and no other case was known to exist anywhere in the vicinity. Subsequently Dr. Brooke learned that one of the house servants had nursed a case of scarlet fever in a distant city just about a year before. After the case terminated she packed some of her things, including some clothing then worn, in a trunk and left the place. A year later she had the trunk sent to her, opened it and took out the contents, the little girl being present and handling the things. Very soon after the latter was attacked, as stated

AN IMPROVED RAILWAY.

According to the invention illustrated herewith, which has been patented by Mr. Robert P. Faddis, of Socorro, New Mexico, a suitable stringer of timber is employed, with recesses in which the ends of metal ties are seated, so that the rails rest flat on the stringers. The tie has its ends divided, or split longitudinally, one portion being then turned upward to engage the outer side edge of each rail, the inner edge of the rail being engaged by a spike driven through an aperture in the tie into the stringer. The ties and stringers are, however, mainly held together by stirrups, which embrace the stringers from below, as shown in the small figure, the arms of the stirrups extending up along the



FADDIS' RAILWAY.

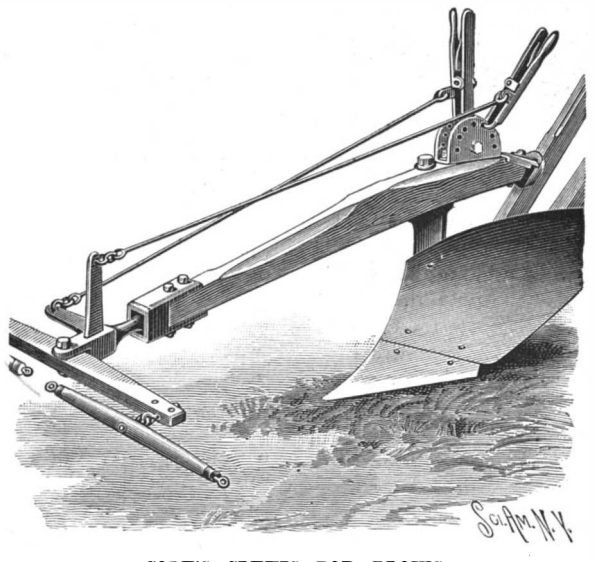
opposite sides of the stringers through the tie and being secured by nuts.

Paper from Wood.

The discovery of the value of wood in paper making is credited to Dr. H. H. Hill, of this city. About forty years ago the doctor visited the paper mill at Vassalboro, and after looking over the machinery suggested the feasibility of using wood, and asked why the manufacturers did not get a few bales of excelsior from Augusta, where it was made, and try the experiment of making paper from wood. "It can't be done," said the manufacturers. "Have not you as much gumption as the hornets, whose nests are made of wood paper?" asked the Doctor. The result of the conversation was a letter, some time later, from the firm's wholesale agents in Boston asking what they were putting in their paper to make it so much better than it had been. It was the wood, then first used in this way.—*Kennebec (Me.) Journal.*

AN IMPROVED PLOW CLEVIS.

A clevis, with mechanism for adjusting it, whereby the clevis may be maintained in proper position during irregular movement of the plow and team, is illustrated herewith, and has been patented by Mr. Marshal T. Cole, of Claremont, Minn. The clevis has a vertical arm and a lateral arm, each connected by adjusting rods with levers pivoted in a U-shaped bracket secured to the plow beam adjacent to the arms of the plow. The rearwardly extending arm of the clevis terminates in a knob or ball, and is connected to the plow beam by the ball resting in a socket formed by two castings bolted to the plow beam, and with recessed heads fitting together, whereby a universal joint connection is made. To hold the clevis in elevated position, and in line with the plow-beam, the levers are adjusted as shown in the illustration, but the direction of the clevis to the right or left may be effected by differently



COLE'S CLEVIS FOR PLOWS.

adjusting one of the levers, or it may be held at a different angle vertically by changing the adjustment of the other lever. By this means the draught connection may be readily altered for a gradual or instant change of depth or width of work, or for both simultaneously, as may be required in ground of different surfaces or variable soil.

© 1889 SCIENTIFIC AMERICAN, INC

GUN COTTON—ITS HISTORY, MANUFACTURE, USE.

BY KARL ROHRER, U. S. N.

The explosive of this name was discovered in 1833 by Braconnot, who dissolved paper and starch in concentrated nitric acid, and recovered a powdery white substance, which burned with a flash when brought in contact with flame.

Pelouze, about the same time, observed that starch so treated gained in weight. He also noticed that by dipping cellulose matter in nitric acid of 1·5 sp. g. it became very inflammable.

In 1846, Schonbein announced the discovery of a new explosive, having four times the power of gun powder, and as being eminently suited to take its place as a propeller of projectiles and in explosive work generally.

Almost simultaneously, Bottger succeeded in producing what he called explosive cotton. He combined with Schonbein to practically utilize their joint discovery.

Otto succeeded in producing gun cotton independently of Schonbein and Bottger, working up from Pelouze's published experiments. Otto's product was weaker than Schonbein's, as he only used nitric acid in its preparation, and not mixed nitric and sulphuric acid, which the latter used. The publishing of Otto's experiments and their results led many expert and amateur chemists to investigating in this field.

Knop, Heeren, and Karmarsch discovered that the best gun cotton was produced by dipping cellulose in the mixed acids, nitric and sulphuric, a fact which was the secret of Schonbein and Bottger.

Publishing and discussing the various ways of producing gun cotton created great excitement in the scientific world of that day. As a humorous scientist put it, "The current literature breathes gun cotton, and the consumption of nitric acid is colossal."

In the meantime efforts were made in France, Russia, and England to introduce gun cotton, and substitute it for gun powder. But the processes of manufacture and the impurity of the raw materials used were such that the results were unsatisfactory. Fatal explosions occurred in France and England in 1848. The political revolutions of that time drew further public attention from the subject.

An Austrian officer, Captain Von Lenk, by study and investigation, succeeded in producing gun cotton which excelled all its predecessors in the regularity of its effect and in its keeping properties. Experiments with it from 1849 to 1853 tended to justify faith in its future, and the Austrian government bought the Schonbein-Bottger patents.

In 1853 the first gun cotton factory established and worked upon a rational plan was erected at Hirtenberg, near Vienna, under Von Lenk's superintendence. His method of manufacture was kept secret until 1862, when he gave it to the French and English, and patented it in the United States in 1864.

In 1865 the Austrian government abolished the use of gun cotton in its service because of two fearful explosions of magazines filled with it, the cause of which could not then be determined.

In this year Abel made the discovery which took gun cotton out of the realm of possibly useful explosives and placed it in that of the safe, practicable, effective, and useful ones. This consisted in pulping it, to admit of its proper purification, and in compressing it to increase its explosive effect. Upon the Von Lenk-Abel method all gun cotton is now produced. Essentially, this method is to dip good and thoroughly cleansed cop or weaver's waste in pure and strong mixed nitric and sulphuric acid—one part by weight of the former and three parts by weight of the latter; to wash, boil, pulp, and liberate the resulting gun cotton from all free acid; then to mould and compress it into the desired shapes and sizes for use.

For the manufacture of gun cotton in the factory established at the naval torpedo station and war college (Fort Wolcott) in 1883, the cotton used is cop or weavers' waste, which is received in bales of about 500 pounds each. (Fig. 2.) The bales are opened, and the cotton is picked over and placed in the cotton boiling tubs, about 200 pounds in each tub (Fig. 3), to which is added about 250 gallons of water and 35 pounds caustic soda. The cotton is boiled in this solution for eight hours, then drained overnight; it is then boiled for eight hours in clear water, again drained, and then thoroughly washed in a centrifugal wringer or extractor. It is thus freed from oil and other impurities.

It is then spread on the wire netting shelves of a suitably arranged dry room, through which hot air, at about 180° F., is circulated, and is sufficiently dried to be picked.

The cotton as received in the bales is full of knots and rolls, and the boiling adds to them. To prepare it for conversion into gun cotton, it is necessary to take them out, that the acid may penetrate easily and quickly through all parts of it. To accomplish this result, the cotton is passed through a picker, a machine common to all cotton factories (Fig. 5).

Having been opened out by the picker, it is dried as thoroughly as possible. This is done by placing it in the wire-netting-bottomed drawers of a specially constructed drier, which is closed when filled, through which, and its contents, hot air at about 225° F. is driven by a Sturtevant blower, which draws its air through a steam heater. In this drier it is left for eight hours, at the end of which time it is estimated that not more than ¼ to ½ of one per cent of moisture remains (Fig. 6). Water is liberated by the action of nitric acid upon cotton, and to avoid weakening the former any more than is absolutely necessary, and to prevent dangerous increase of temperature, the latter must be as dry as possible.

When dry the cotton is stowed away in powder tanks (Fig. 7), so that it may be conveniently handled, and also kept dry. It is now ready for the conversion process.

This is carried on in the dipping room, which is fitted with cast iron dipping troughs, located in a tank of running water, proper cooling troughs, and acid reservoirs. The acid used is received already mixed, contained in iron drums of about 1,200 lb. capacity. The mixture is, as nearly as possible, one part by weight of pure nitric acid of 1·5 specific gravity to three parts by weight of pure sulphuric acid of 1·85 specific gravity, and costs 3¼ cents a pound. As in the converting and the two succeeding steps of the purification process a great deal of acid fume is liberated, the dipping and two following pieces of apparatus are connected with a fan, to take it up and drive it out. The prepared cotton is brought to the dipping room on the railway running through the factory. The dipper fills the troughs with acid and arranges his tools for use. The helper weighs out a pound of dry cotton, with which he approaches the dipper, and pitching about a third of it into the acid (Fig. 8), the latter submerges it with a steel fork, made for the purpose, and so on, until the first trough is charged with the pound of cotton. The other three troughs are similarly charged. When about ten minutes have elapsed, the dipper returns to the first trough, and with the fork gathers the gun cotton out of the acid and puts it on a grating at its further end, and there squeezes the surplus acid out with a hand press (Figs. 9 and 10). By the time this is done, the helper has placed a stone jar, into which the two place the gun cotton from the first trough. The helper presses it down in the jar, puts a cover over, and sets it in a cooling trough. The dipper replenishes the acid, and the trough is charged with cotton as before, and so on, until the day's dipping, about 110 pounds, is finished. The jars are left in the cooling troughs overnight, so that their contents may thoroughly digest, and there remain no unconverted particles of cotton (Fig. 12).

From the cooling troughs, the gun cotton is taken to a centrifugal wringer, two jars at a time, in which the acid is extracted and caught in a drum (Fig. 13). This spent acid is sold to the acid manufacturers for three-quarters of a cent a pound. Extracting it is a delicate operation, and great care must be taken that no oil or water finds its way into the wringer, for, if it does, the gun cotton will be ignited, and, under such circumstances, it is very difficult to draw the line between a fire and an explosion.

The gun cotton, having been approximately freed from acid, is taken to the immersing tub, in which washing out the free acid is begun (Fig. 14). Immersing acid gun cotton in water is dangerous, and must be carefully and intelligently done. In this tub revolves a paddle wheel, over which is a hopper, which communicates with the wheel by a slot. The gun cotton is brought from the wringer in a tray, and placed in the hopper, from which it is fed by separate handfuls, down the slot, upon the revolving wheel, and into the flowing water in the tub. If it is otherwise fed down to the wheel, so much heat is developed in that part at the edge of the water that it may ignite, and burn the contents of the hopper, and do other damage.

The gun cotton is taken out of the immersing tub, and thoroughly washed in a centrifugal wringer, and then placed in a gun cotton boiling tub. These tubs are similar to the cotton boiling tubs, differing from them in having the steam enter through the top, going to the bottom, then through a coil, and out. The boiling space is insulated from the metal pipes by perforated boxing. Live steam does not come into contact with the gun cotton, nor does the metal of the steam pipe. In this tub it is boiled in fresh water, and 10 lb. of carbonate of soda, for eight hours. It is then drained, and thoroughly washed in a centrifugal wringer, and boiled again for eight hours, in fresh water, and again drained, and washed as before.

After the second boiling and washing, it is taken to the pulping machine (Fig. 15), which is similar to the machine used in paper mills, for pulping paper stock. In this machine, which is suitably filled with water, it circulates between the knives until pulped to about the fineness of corn meal.

From the pulping machine it is drawn off into a poacher, which is a large oval tub provided with a paddle wheel in the middle of one side, working just clear of a platform with inclined approaches (Fig. 16). The pulp and a sufficient quantity of water being in the poacher, its paddle wheel is made to revolve, which causes both pulp and water to circulate, and the latter to wash the former. After an hour's washing the paddle wheel is stopped, upon which the gun cotton settles to the bottom. The soiled wash water is drawn off by means of a telescopic pipe at one end of the poacher. Fresh water is added, and the cleansing continued until the washing water ceases to become soiled. The gun cotton is then supposed to be clean and without free acid.

A sample is taken from the bottom of the poacher, and submitted to the solubility test, to determine what percentage of soluble gun cotton it contains, which must be less than ten per cent. The lower orders of gun cotton are soluble in a solution of one part alcohol and two parts ether, and by means of this solution the test is made. It is then submitted to the heat test, to determine whether any free acid remains. To make this test, small quantities of the sample, thoroughly dried, are placed in test tubes which are filled in a hot water bath, carrying a suitable thermometer. The mouths of the test tubes are closed with corks, under which are suspended pieces of iodide starch paper, which has been very carefully prepared. The bath is heated to 150° Fah., and the gun cotton must bear this temperature for not less than fifteen minutes, without turning the test paper brown.

Having passed the tests, the next step is to prepare it for service use. To every poacher full of it there is added three pounds precipitated chalk, three pounds caustic soda, and three hundred gallons of lime water. So fortified with alkali, it is pumped into what is called the stuff chest, a round tank with a vertical shaft, carrying feathers to keep the pulp agitated and mixed with the water (Fig. 17).

The gun cotton being in the stuff chest is drawn thence and moulded, or pressed into shape for compressing, which is accomplished by means of a hydraulic press arranged for the purpose. Knowing the size of the compressed block desired, it is determined by experiment how much of the pulp is necessary to produce it, increasing or decreasing the length of stroke of the press pistons, then the moulding is proceeded with. The standard gun cotton block for naval use is 2·9 inches square and 2 inches high (Figs. 20 and 21), to produce which the moulded block must be 2·8 inches square and 5½ inches high (Fig. 19), moulding at a pressure of 100 pounds to the square inch.

From the moulding press the blocks are taken to the final press, which is one of Sellers hydraulic presses with an 18 inch ram (Fig. 18). In the receiver of this press the moulded blocks are placed between two perforated steel plates, a traveling block is then hauled over and the pump started, which forces up the ram and the pistons on top of it, which act on the gun cotton in the receiver. The naval service gun cotton is compressed at three tons to the square inch, and leaves the press with from 12 to 16 per cent of moisture, which is increased to about 35 per cent before issue to the service. It goes into the service packed in the standard tin exercise torpedoes and tinned sheet iron service torpedoes, which are capable of being made water and air tight, and have the necessary fitments for filling, fusing, and being attached to spars preparatory to explosion (Figs. 22 and 23).

The public owes much to the various experimenters with gun cotton, but owes most to Von Lenk and Abel. The former determined the facts that the strongest and best gun cotton is secured from the purest and best raw materials, and that to make it safe, its free acid must be extracted. The latter discovered how to make it safe, and how to increase its explosive effect. He also realized its true sphere of usefulness.

The filaments of cotton in the natural state are hollow, and all the spinning, weaving, and other processes to which it is subjected in the manufacturing and commercial worlds fail to destroy these tubes, as they may be called. Their existence caused the failure of the early gun cotton makers, because, upon dipping the cotton into acid, it permeated the hollows of the filaments, and no ordinary method of washing served to extract it. With free acid in gun cotton it is a question of short time for decomposition to begin, and explosion to follow.

Abel, by discovering the pulping process, enabled the gun cotton to be thoroughly purified of free acid; as by pulping the filaments are broken up, and the worker is able to wash it out. Again, by fortifying the purified pulp with a percentage of alkali to neutralize the nitrous exhalations which all nitrated bodies give off, sooner or later, and then compressing this purified product, he presented to the military world the ideal explosive for its purposes.

It is extensively manufactured in England, by government as well as by private individuals. In Germany, Italy, Austria, and other countries it is manufactured by private parties. It is used by the military services of the whole world, and is constantly growing in favor. The Chinese and Japanese are taking steps to establish their own factories, and thus free themselves from the European manufacturers.

The United States government should to-day have a half million tons of it, contained in torpedo and mine cases, distributed along the Atlantic, Gulf, Pacific, and

© 1889 SCIENTIFIC AMERICAN, INC

lake coast, and at central distribution points along that line. It should also have a well drilled and organized naval militia, prepared to lay them out properly and put the life of death into them for those who attack us.

In these days, when the Monroe doctrine is expounded to embrace islands 2,000 miles and more from the continent; when interoceanic canals are to be controlled; and when it is the mode to twist the tails of the British and Spanish lions, to pull feathers from the Gallic cock and the eagles of Germany and Austria, it were well that many and rapid steps be taken to enable the country to maintain and prosecute a fight, if one should be developed. From the point of view of one to whom war means promotion, aggressive foreign policy might be very promising, other things being equal. Alas! other things are not equal; and while this country, in area, wealth, population, and latent defensive and offensive war strength, ranks among the highest of first class nations, yet in its immediately available defensive and offensive power, upon the sudden declaration of war, it ranks little, if any, higher than Denmark. Modern guns, forts, ships, torpedoes, mines, and gun cotton must be accumulated, and the fighting strength of the nation trained in their use.

Wet compressed gun cotton is the safest high explosive yet produced. It can be readily and safely transported by any conveyance whatever. It is eminently convenient and safe to handle, store, and work with. It can be sawed, turned, cut, and bored easily and with perfect safety; and the turnings, cuttings, and borings may be worked over, as may old, distorted, or obsolete shapes. It can be compressed in any shapes or sizes.

Dry compressed gun cotton is safer, in every way, than gun powder, and a very small percentage of the whole weight of any charge for explosive work need be dry.

In view of the daily accidents with the ordinary market high explosives, it is pertinent to ask what would happen if the work of lining our whole coast with mines and torpedoes charged therewith were attempted? Our defense would be as dangerous to ourselves as to our enemy. No man fights well who is afraid of his weapon.

The time has arrived for private enterprise to take hold of gun cotton. The processes and machinery for its manufacture can be greatly simplified and improved, and its sphere of usefulness much increased. It is certain that the overweening common sense of our naval and military ordnance authorities will, in the near future, cause it to be adopted as the normal high explosive for government use. Even now, reasonable inducement might be received for private parties to move in the matter.

As superintendent of the factory whose processes this paper describes, I have, in the past three years, made many tons of it, handling it under various circumstances, in both the wet and dry states, without injury to person or property.

That Ache in the Back.

An Albany physician, says a contemporary, declares that Americans suffer more generally from Bright's disease and nervous diseases than any other people, and he says the reason is that Americans sit down so persistently at their work. He says: "Americans are the greatest sitters I ever knew. While Englishmen, Germans, and Frenchmen walk and exercise, an American business man will go to his office, take his seat in his chair and sit there all day without giving any relief to the tension of the muscles of the back. The result is that these muscles surrounding the kidneys become soft and flabby. They lose their vitality. The kidneys themselves soon become weak and debilitated. If Americans would exercise more, if they would stand at their desks rather than sit, we would hear less of Bright's disease. I knew of a New York man who had suffered for some years from nervous prostration until it was recommended to him that he have a desk at which he could stand to do his work. Within a year he was one of the healthiest men you ever saw. His dyspepsia and kidney trouble had disappeared, and he had an appetite like a paver."

A Mountain of Iron.

Dr. Noetling, of the Geological Survey of India, in a recent report on magnetic rock among the Shan Hills of Upper Burmah, describes a mountain or hill at Singaung which "consists of a huge mass of iron ore." Having, he says, noticed on the way numerous pieces of iron ore, which became still more frequent on the southern side of the hill, he examined the latter in several directions. He found the surface everywhere covered with large blocks of iron ore, originating evidently from superficial decomposition of lower beds. He concluded that the whole hill consisted of a large mass of iron ore. He was unable to ascertain the geological conditions under which this ore occurs, or its exact limits and extensions, on account of the dense jungle and the tremendous attraction, rendering his compass useless. He estimates, however, that the hill covers, at least, an area of about a square mile, and that it rises about 200 feet above the level of the Twiunge valley. The ore is hematite peroxide of iron.

Correspondence.

Wheat in Geranium Stalk.

To the Editor of the Scientific American:

A peculiar growth has lately come to my notice, which may be of interest to some of your readers. About three weeks ago I was told, when about to plant some geranium cuttings, that if the lower end of a cutting was split and a grain of wheat inserted, it would much promote the growth, so I tried the experiment. It did not have the desired effect, as the cutting never grew at all; but when I pulled it up I found that the wheat grain had grown to the height of about 7 inches up through the pith of the cutting, and had two perfectly formed pale green leaves, closely folded up within. The only part of the wheat projecting from the geranium was about one inch of root. WM. H. P.

The Great Lakes.

To the Editor of the Scientific American:

I accidentally, a few weeks since, came in possession of the SCIENTIFIC AMERICAN of August 18, 1888, in which I read an article on the formation and changes of the level of the great lakes, by Mr. C. K. Gilbert. I was greatly interested in his theory and opinion of the changes of level of Lake Erie, of Lake Huron, of Lake Michigan, and Lake Superior. It is evident from the indications and marks on the south shore of Lake Erie that that body of water was, at some anterior date, many feet above the present level. Also, that Lake Huron's and Lake Michigan's present levels are many feet lower than they were at some anterior date.

In 1835 and 1836 I traveled on foot through the region of country from the southwest portion bordering on Lake Michigan in a southwest course to the Desplaines River, commencing some six miles south of Chicago, near or at the mouth of the Calumet River. The country at that time (1835) was a low, swampy region for some four or five miles in width, extending in a south by west direction toward the Desplaines River. Some ten or twelve miles from Lake Michigan, the low, swampy character of the land was contracted to about a mile in width, and from that point on to the Desplaines River was known as or called the sag. This sag was a wet, swampy piece of land, almost impassable, overgrown with long swamp grass and flags. This was the general character of the sag, or low ground, until it united with the Desplaines River, some six or eight miles above the town of Joliet. This low ground, commencing at Lake Michigan, and the sag, or valley, has every appearance of once being the bed of a large river. In June, 1835, I was at the town of Joliet, which had then but four or five buildings—but one house on the east side of the river (Desplaines) and three or four buildings on the west side of the river.

The valley of the Desplaines River, from the junction of this low, swampy sag, or valley, I should say is from one-half to three-quarters of a mile in width from thence to its union with the Kankakee River. From Joliet I traveled on foot down this valley, following an Indian trail most of the way to within a short distance of the town of Ottawa. The peculiar formation of the bottom, or land, of this valley, between the bluffs, was such that it led me to believe it was, at some ancient period of the world's history, washed by a large river. At Joliet, on the east side of the river, there was no soil of consequence. The valley was covered with round, coarse gravel and sand for from six to ten inches or more in depth; then the rock formation commenced; this extended down the valley for some two miles. This coarse gravel and small stones had every appearance of having been washed by water, they being so round and smooth. Some three or four miles below Joliet there is a mound, or mountain, as it was called at the time (1835) that I was looking at the country. This valley, on each side of the mound, had every appearance of having been washed by a large river. This mound is, I judge, some 60 or 80 feet in height, and the top of the mound is on a level with the country on either side of the valley. The top of this mound contains several acres of rich soil of the same character as the prairies in that vicinity. The upper end of this mound, at the base, is composed of a ledge of rock. There are also distributed throughout this valley, to its junction with the Fox River at the town of Ottawa, numerous small mounds, from 15 to 20 feet high. All of these had the appearance as if they were islands in the bed of a river. The formation of these mounds was precisely that of all islands in large rivers—broad and round at the upper end, and washed to a point at the lower end like this . From the town of Ottawa to the town of Peru, the head of navigation on the Illinois River, the bluffs on either side of the river have the appearance of having been washed by the waters of a vast river. In fact, the Illinois River, with its tributary, the Desplaines, to its union with the Mississippi, I have no doubt, was the channel through which the waters of the great lakes, Erie, Huron, Superior, and Michigan, once found their way to the Gulf of Mexico.

There is no question, in the minds of scientific men, as to the fact that the surface of these lakes was many feet higher than at the present time. From the formation of the surface of the country at the southwest end of Lake Michigan, some ten or twelve feet elevation of this lake would discharge the water through the channel above mentioned into the Illinois River. There is no doubt but the ridge of rock formation extending from Lockport to and across the Niagara River was, at some anterior age of the world, a barrier to the outlet of Lake Erie; hence the evidence from indications on the south shore of the lake shows that the water of the lake was from forty to fifty feet higher than at the present time. There is, according to engineering surveys, but twenty-two feet fall from Lake Huron to Lake Erie; hence this elevated ridge of land crossing the Niagara River would be a barrier to the outlet of Lake Erie into Lake Ontario. Therefore the waters of Lake Erie flowed into Lake Huron and through the Straits of Mackinac into Lake Michigan and thence through the Illinois River to the Gulf of Mexico.

C. T. S.

Creolin in the Local Preventive and Curative Treatment of Infectious Throat Diseases.

BY F. W. KOEHLER, M.D., LOUISVILLE, KY.

In Nos. 17, 18, and 19 of the current volume of the *Wiener Medizin. Wochenschrift*, Dr. James Eisenberg describes a series of experiments made with the new antiseptic creolin. He shows it to be an extremely powerful germicide, and yet, even in large doses, altogether harmless to man. These qualities made it appear to me an ideal remedy for the preventive and curative treatment of infectious throat troubles. Adults can use gargles of the ordinary poisonous antiseptics, like the bichloride of mercury, but for children something is needed which can be safely swallowed. Soon after I had read Dr. Eisenberg's article I procured a supply of the creolin, and have since used it to the exclusion of other local applications. My success with it has been very pleasing indeed. In treating infectious throat troubles, I now always put not only the patient, but also all the well members of the household, on the creolin treatment. Thus I have prevented, I think, diphtheroid sore throat from going through entire families of children, which it had previously, under other modes of treatment, always done.

But it is as a preventive of true diphtheria that I expect most from the creolin. Dr. Eisenberg's experiments show that no form of pathogenic germ can resist its action; and it is therefore reasonable to suppose that the germ of this disease will also succumb to it. Recently I was called to see an old lady, who, a day or two after exposure to a case of diphtheria (proved to be so by paralysis occurring several weeks afterward), was taken sick with rigors, fever, and sore throat. Almost simultaneously her daughter and son-in-law were taken in the same way; but her little grandchild, a boy of four years, showed no signs of the disease when I was called. I at once, however, put him, as well as the others, on the creolin treatment. The child, although always rather predisposed to throat and bronchial trouble, escaped an attack altogether, and his parents and grandmother recovered promptly.

Diphtheria is certainly one of the most dreadful diseases that confront us, and any treatment that might reasonably be expected to prevent its spread should be given a trial. I am inclined to believe that if the mouths, throats, and nasal passages of children were kept as clean as their faces, there would be much less of the disease. When diphtheria prevails, no child's toilet should be considered complete until the upper air passages have been thoroughly douched with some suitable antiseptic; and in the long list of such agents I know of none that fulfills the requirements so well as creolin.—*Medical Record.*

Good Counsel.

How true it is, as the *Practical Mechanic* says, thousands start well, but never finish one thing at a time. They have a dozen things on hand and no one completed. Time is wasted on unfinished work. Always finish what you begin. One thing finished is worth a hundred half done. The completion of an undertaking yields more pleasure and profit than dozens of plans. The man who is always planning or scheming is rarely, if ever, successful. He often furnishes ideas for others, who go persistently to work and finish what his ideas suggested. "That was my idea—my plan," we frequently hear some one say, but the man who carried it out was the one who benefited himself and others. Do not begin what you cannot finish. What you undertake to do, *do*, and reap the reward of your own ideas and skill. This is good advice both in and out of the shop.

New Automatic Rifle.

A new automatic magazine rifle, invented by R. Dewhurst and H. A. Pitcher, has been brought out at Neillsville, Wisconsin, where it is making quite a sensation. Like the Maxim gun, the cartridges may be fired singly, by pulling the trigger for each desired discharge, or the gun may be set so as to fire itself off, with great rapidity, until all the cartridges in the magazine are used.

© 1889 SCIENTIFIC AMERICAN, INC

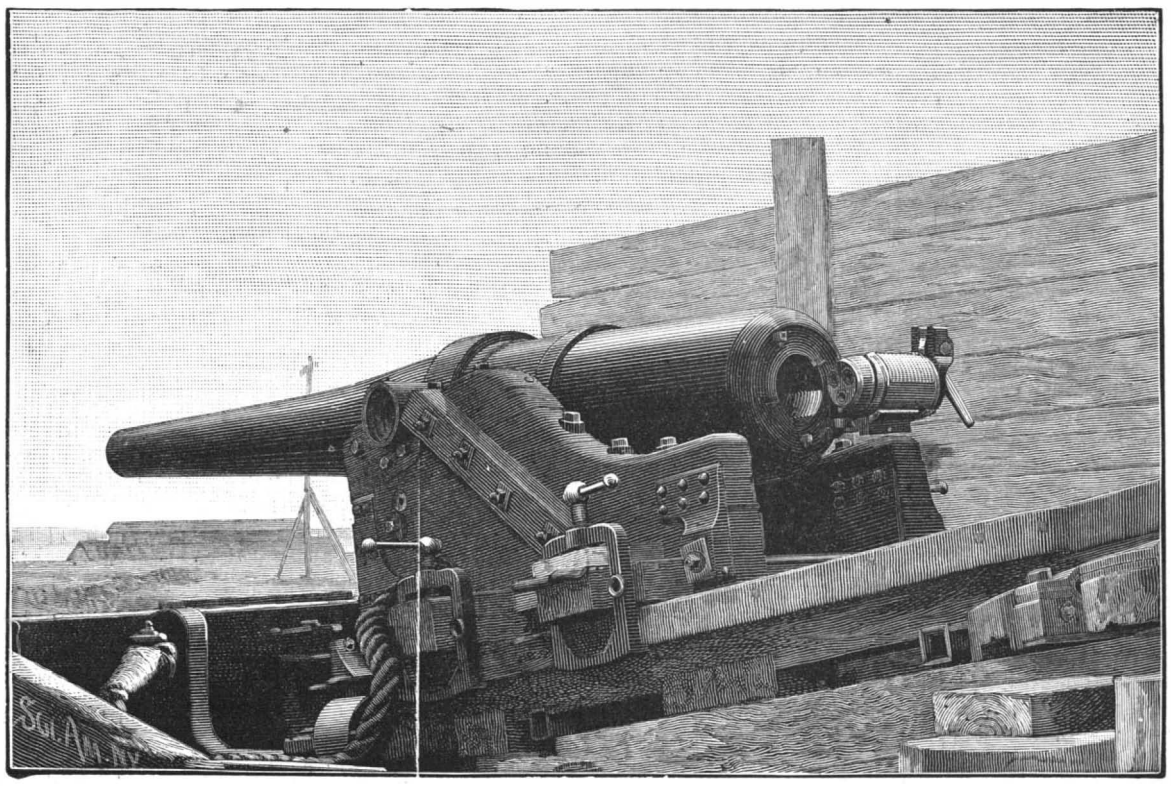
TEST OF THE CAST STEEL BREECH LOADING RIFLE OF OPEN HEARTH STEEL.

An act of Congress approved March 3, 1887, appropriated $20,400 for the purchase and completion of three rough-bored and turned steel cast 6 inch guns, one to be of Bessemer steel, one of open hearth, and one of crucible steel. One gun of Bessemer and one of open hearth steel have been finished, but no proposals for a crucible steel gun have as yet been received by the navy department. These castings were to be of domestic manufacture, of best quality of raw material, uniform in quality and free from all imperfections of casting. The guns were to be of one piece, except the trunnion band, if so desired, and they were not to be forged.

The test and bursting of the gun of Bessemer steel was described in our issue of December 29, 1888. The second gun, of open hearth steel, has recently been tried at the proving ground, at Annapolis. In external appearance it differs from the former gun in having a trunnion band of cast steel screwed on, instead of having its trunnions cast solid with the rest of the piece. It also has a slightly greater diameter across the cylinder or breech, and is nearly three thousand pounds heavier than the Bessemer steel rifle. The gun was cast, rough-bored and turned by the Standard Steel Casting Company, of Thurlow, Pa., and was finebored, chambered, and rifled at the gun shops at the Washington navy yard. As in the case of the Bessemer steel gun, the interior work shows most creditable machining by the government workmen at the navy yard. The interior profile was made exactly the same as that of the service 6 inch rifles of Bureau of Ordnance design, so that direct comparison could be made of ballistic results from the two classes of guns. The naval built-up gun is considerably lighter than the cast steel gun, its weight being about 10,800 pounds, as against 13,125 pounds for the Thurlow gun.

The physical characteristics of specimens from this casting are quite uniform. With the eight specimens experimented upon, the ultimate tensile strength varied from 79,246 pounds to 81,334 pounds, the elastic limit varied from 36,414 to 38,961 pounds, while the elongation ranged from 19·10 to 27·85 per cent.

As will be seen from the plan of the gun, the breech is a cylinder, while forward of the trunnions the profile of the chase and muzzle slope away in a curve of such a trend as to make the resistance of the gun at any point correspond with the ordinate of the pressure curve at that point. The breech is closed on the interrupted screw system used in most breech-loading guns. The De Bange pad seals the joint between breech plug and gun chamber, preventing any escape of gas to the rear, and the front face of the "mushroom" or nose plate is fitted with the housings of three gauges for recording the gas pressure in the chamber of the gun. The following are the principal dimensions of the gun:



RECENT TEST OF 6 IN. CAST STEEL BREECH LOADING RIFLE.

Length	193·5	inches.
Length of bore in calibers	30	cals.
Diameter across breech	22·2	inches.
" of bore across lands	6·0	"
" " powder chamber	7·5	"
Capacity " " "	1,400	cu. in.
Twist of rifling—increasing from 1 turn in 180 calibers to 1 turn in 30 calibers at muzzle.		
Weight of gun	13,125	lb.
" " projectile	100	"
" " powder charge	48¼	lb.

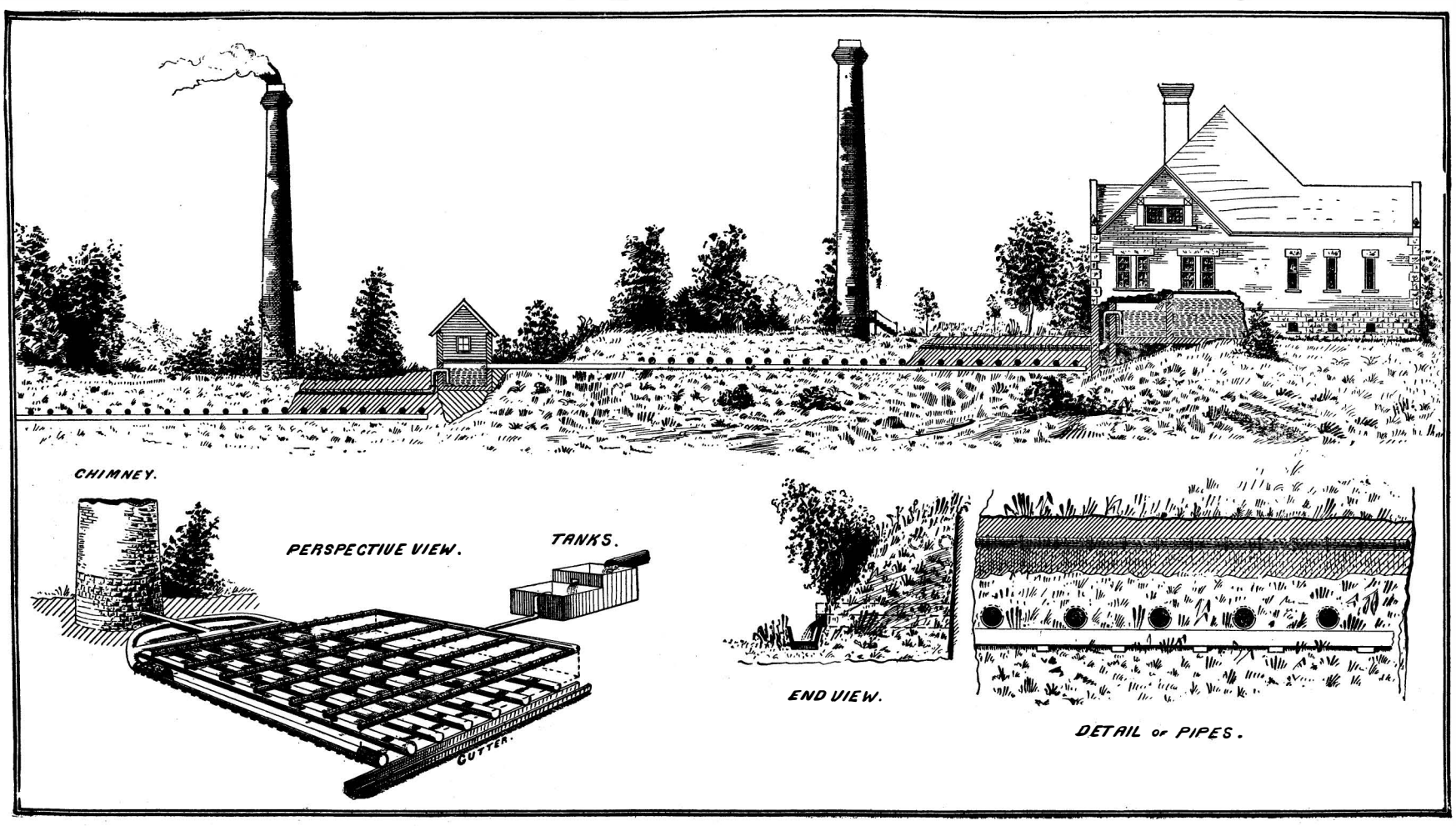
There are 24 lands and grooves, the rifling being of a modified ratchet system. The projectile is fitted with a soft copper band near its base, of a diameter greater than that of the bore across grooves. When the gun is fired, the band is forced into the rifling as the projectile moves down the bore, and thus the necessary spin is given the shell. The projectiles were the common cast iron shells, cored for a bursting charge of five pounds of powder; but in tests of this kind at the proving ground the shells are not filled with powder, being brought up to the standard weight (100 pounds) with sand.

The powder used in the trial was the regular naval 6 inch gunpowder, manufactured by Messrs. Du Pont, at Wilmington. It is known as brown prismatic or cocoa powder, from its color, and is pressed in hexagonal prisms one inch high, each prism pierced with a quarter inch hole in its axis for ignition. Ten grains weigh one pound, the specific gravity being about 1·825. One of these grains, if ignited in the open air, will burn for eight or ten seconds before being consumed; but when under pressure, as in a gun, its rate of combustion is very rapid, although slow compared to that of ordinary black powder, which is not used for high powered guns, being far too violent and irregular in its action.

The charge of 48¼ pounds is known as the full service charge for naval 6 inch guns, and from a long record of firing at the proving ground can be depended upon to give a 100 pound shell a velocity of 2,000 feet per second, with a pressure in the gun chamber of about 15 tons to the square inch. The test ordered by act of Congress was to include ten of these full charges, delivered from the gun as rapidly as possible. Preparatory to the firing trial, the gun was mounted on an old-fashioned wooden carriage, with the slide inclined upward to the rear, so that the piece would run to battery again after its recoil. Recoil was controlled by friction compressors on the sides of the carriage, set up with screws, and a stout hemp breeching, with rubber buffers in rear. Bomb proofs were provided for officers and gun servants, and heavy bulkheads or traverses of timber and sand bags protected the other guns and carriages on the platform from injury from flying fragments.

The trial took place on February 7, 1889, and was under the direction of Lieutenant-Commander J. H. Dayton, Inspector of Ordnance in charge of the Proving Ground, assisted by Lieutenants F. A. Wilner and V. S. Nelson and Ensign R. B. Dashiell. Many naval officers from the Academy and representatives of the steel casting company and of the press were present.

Before the rapid fire test with ten rounds, two rounds with reduced charges of 36 pounds were fired



TERRACED IRRIGATION PROCESS OF SEWAGE DISPOSAL.

© 1889 SCIENTIFIC AMERICAN, INC

to set the gas check and warm the gun. These charges gave pressures from previous records of about 11 tons to the square inch. When all was ready, ten rounds, with full charges and projectiles, were fired rapidly, the ten shots being delivered in 19 minutes and 8 seconds.

The gun stood the ordeal without rupture, being the first American high-powered cast steel gun that has endured a full charge firing test of ten rounds. Whether the piece has been injuriously enlarged or strained in the trial, extended experiment alone can show.

TERRACED IRRIGATION PROCESS OF SEWAGE DISPOSAL.

T. O'CONOR SLOANE, PH.D.

The problem of sewage disposal cannot as yet be said to be adequately solved. In England, sanitarians propose new methods of treatment continually. Disinfection by chemical treatment, precipitation of the solid matter by mechanical deposition, or its removal by filtration have all been tried in every conceivable modification. Even electricity has been called in, and the electrolytic treatment is now exciting considerable attention. It is possible that a wrong conception underlies these attempts. A perfect method seems hardly realizable. Different circumstances make each case individual, and exact individual treatment.

For small systems, the subsoil irrigation method has, up to the present, met with perhaps the greatest success. Under proper conditions, it is quite inoffensive, and can dispose of large quantities of fluid. Its general principle involves the sudden and periodical delivery of the more liquid portions of sewage over a large area of ground about eighteen inches beneath the surface. The liquid matter is disposed of in three ways. A part is absorbed by the roots of the vegetation covering the soil. This portion naturally varies in amount, and in summer is far greater than in winter. A second part evaporates, after penetrating the overlying soil. A third part sinks into the subsoil.

To make the system work well, a piece of ground not too depressed must be chosen, in order that this drainage of the third portion, as specified above, may be effectual. If the soil is saturated with natural moisture, it will not answer as a filter bed. In such a case, subsoil drainage pipes must be put in below the irrigation system. The water collected by the subsoil lines will be more or less purified by the downward filtration. It will be diluted by natural water so as to be less offensive, and in many cases it can be delivered to the natural overground water courses without perceptibly polluting them. If the stream or river ultimately receiving the outflow should be in some degree polluted, it will, sooner or later, become pure again from the effects of aeration. Simple contact of running water with the air tends to purify it from offensive matter. The more broken the course of the water, and the thinner the sheet in which it is exposed to the air, the more effectual will be its purification for a given distance or time.

All these principles and methods are utilized in the arrangement here illustrated. The Waring or subsoil irrigation disposal is the basis of the work. The system is represented as applied to providing a sewage works for a small village or community.

For the sewage farm and disposal works, a piece of ground should be chosen that is lower than any of the area included in the sewer or drainage system. The field or farm must vary in level; one portion must be at least five feet lower than the other, a greater difference being desirable. This is easily secured by having a reasonably large piece of ground devoted to the work. Some kind of surface drainage—a stream or river is best—should be obtainable near at hand.

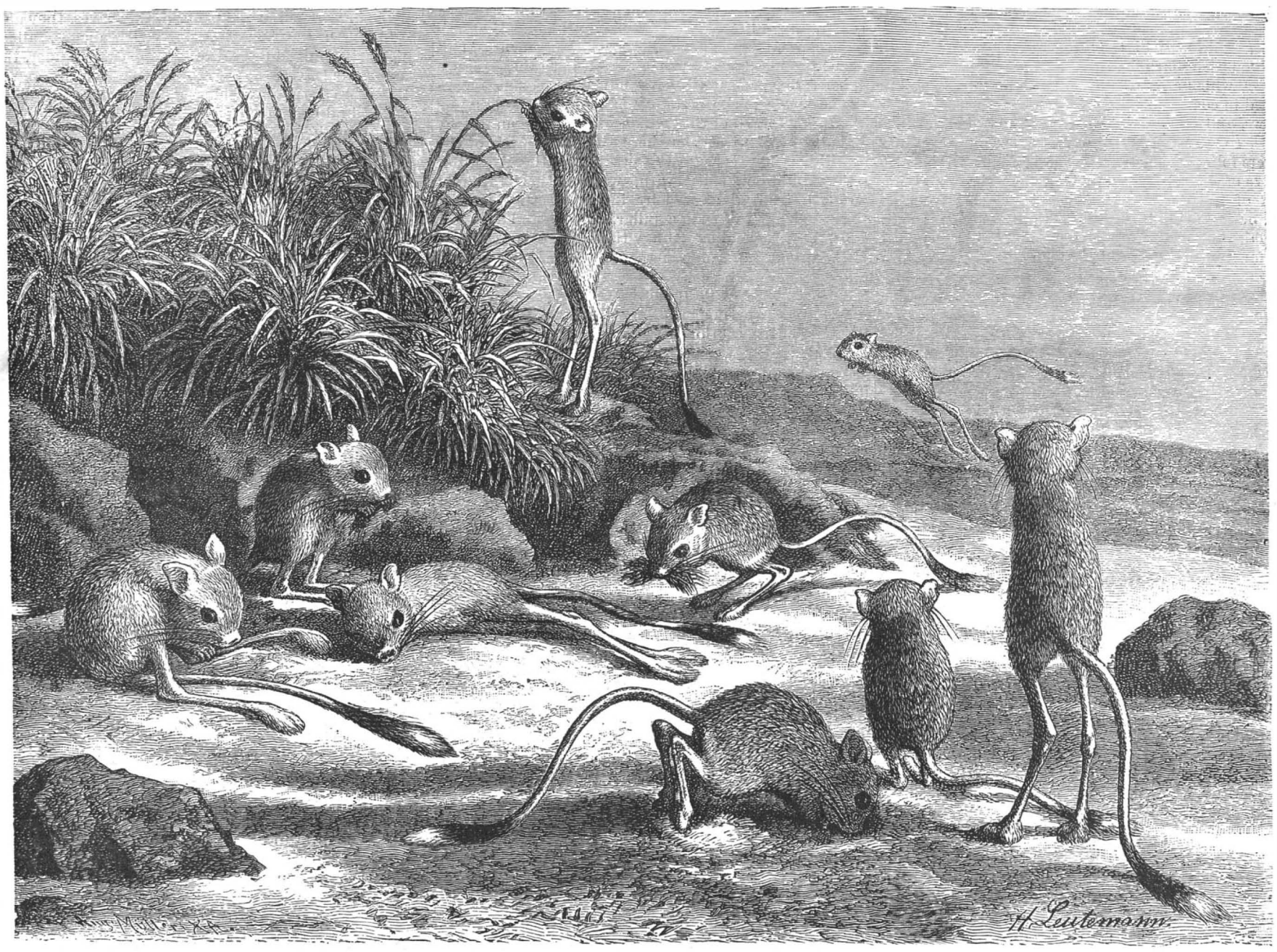
The sewage is received in a settling tank. In this receptacle it may be treated with chemicals, or it may receive them before entering. If in an isolated locality, the natural precipitation may suffice, the chamber containing the tank being properly ventilated. The principal object of chemicals would be to deodorize it. From the settling tank it overflows into the siphoning tank. From this it is periodically discharged by a siphon of any of the well known types. The liquid matter runs into the sub-surface perforated irrigation pipes, and is distributed through the soil.

Where a systematic sewage disposal is the whole function of the area, plants can be selected for cultivation upon the sewage bed that have the greatest power of assimilating water. Red clover is a good instance, as its roots penetrate very deeply. Perennial or hardy crops might exercise a good effect, even in winter. No attempt should be made to obtain a paying result. The disposal works should be treated as a subject of expense, not of profit.

Three to five or more feet under the sub-surface pipes, a set of regular subsoil drainage pipes are placed. These are represented in the illustration as crossing the others at right angles, though the relative disposition is really immaterial. At one or more places the higher ends of these pipes are connected to a high chimney. This maintains a continual aeration of the pipes and water flowing through them. If necessary, a fire may be maintained in the base of the chimney to increase the draught. The lower ends of the drain pipes deliver their flow to a conduit. These ends must be unobstructed and open, and in laying the lines care should be taken to preserve an even pitch of considerable degree, so as to prevent the possibility of the formation of traps. The air which the chimney will draw through the pipes will play an important part in purifying the drainage water.

The diluted and filtered and partly aerated sewage water collected in the conduit is conducted to a low level siphoning tank, which delivers it to a second irrigation bed. There it is subjected to a repetition of the treatment just described, including the three purifying elements of filtration, aeration, and dilution. The water finally delivered to the low level conduit will be comparatively innocuous. It will have been twice filtered, aerated, diluted, and acted on by vegetation and humus. Its purification will have progressed in something like a geometrical proportion.

It will be observed that the above description refers to the disposal of the liquid matter. The removal of solid matter is the simplest part of the problem, and can be effected in any of the well known ways. When the aqueous portions of sewage are disposed of, nine tenths of the problem is solved.



THE JERBOA—[DIPUS ÆGYPTIUS LICHTST.]

THE JERBOA.

In the diluvial strata of clay at Thiede, near Wolfenbuttel and Westeregeln in the peat district of Magdeburg, Nehring found many fossil remains of the jerboa among other rodents of the plain, and also, as comparison with modern skeletons proves, of a kind of jumping rabbit which is identical with the *Alactaga jaculus Brdt.*, still found in the steppes of southwest Siberia and Central Asia. This proves that in the so-called post-glacial period the North German plain, as far back as the mountains of Central Germany, presented the same general character as the steppes, and had a Continental climate; that is, a hotter summer and a colder winter than at the present time. But it is not probable that the coast of the European continent then had its present form, to which the North German plain owes its moist and mild climate. Europe, especially the western part, must then have been connected with the northern part of Africa, forming a compact continent. Later changes in the divisions of land and water were caused by upheavals and sinkings of the surface of the earth, the sea making a deep impression in the European-African continent. The result of this

© 1889 SCIENTIFIC AMERICAN, INC

was a change of climate and, consequently, of vegetation, particularly in southern and western Europe. The steppes were changed into woods and swamps, and Germany assumed the characteristic features described to us by Cæsar and Tacitus. Under these circumstances the little rodents of the steppes could not exist, so they fled from the encroaching swamp back into the steppes of Eastern Europe and Asia, where they are still found.

The accompanying illustrations will give our readers an excellent idea of the habits of the jerboa, the roguish gnome of the desert; the manner in which they steal out of their holes at twilight, when the shadows are lengthening; their ways of cleaning themselves, of eating, resting, carrying building materials, of standing upright on their toes so as to nibble the tender tops of the grass, of supporting themselves by their long tails when sitting upright, of digging, etc. These excellent drawings were made by the well known animal painter L. Leutemann.

The coat of the jerboa is a grayish-yellow, a real sand color, on the back; the belly is white, and the two rows of hair on the end of the tail are first dark brown and then white.

The species shown in our cuts is the North African, desert jerboa (*Dipus aegyptius Lichtst.*), which is scattered over the northern part of Arabia, Egypt, and Tripoli, living gregariously in this dry, barren ground, which is covered with sharp reed grass. There they make their burrows, which are provided with many branches, and are used in common. They have their entrances, their burrows, and an escape, which extends nearly to the surface, so that they can break through in case their pursuers follow them into their holes, as the naja, also a native of this region, often does. Sometimes the lynx, or fox of the desert, surprises a jerboa far from its home, or the owl in its noiseless flight seizes one; but, as usual, man is its worst enemy. The Arabs hunt them for their flesh, catching them dead or alive in a simple manner: they break up their burrows with long poles. Many jerboas are kept in captivity, to which they soon accustom themselves. It is easy to make a nest for them. A common wooden box, the larger the better, of course, lined with sheet metal, filled a foot high with closely packed earth, and covered with wire netting, will answer perfectly. They are such neat little animals that they can be kept in a warm room without causing any annoyance. They will thrive if fed on grain, with some bread and carrots, and their funny, merry little ways at evening, the noiseless running back and forth, will richly reward the owner for the little trouble they cause.

We have taken the accompanying illustrations from "Die Natur," with the consent of the publisher.—*Illustrirte Zeitung.*

Proposed Ship Canal between Bristol and English Channels.

A scheme for connecting the Bristol and English Channels will be brought prominently before the public in the course of a few months. The route fixed upon by the engineers who have recently surveyed the district is from Stolford, in Bridgewater Bay, passing through the towns of Bridgewater, Langport, Ilminster, and Chard, to Seaton, on the English Channel. The total length of the canal will be about 45 miles, and, with the exception of the Chard range of hills, the work of excavating, etc., for the whole distance will be comparatively easy, no engineering difficulties presenting themselves. The Chard district is formed of lias, so that in excavating through the high ground an ample supply of lime will be obtained, which will be useful for the other portions of the work. The canal is intended to be in every way capable of admitting the largest mercantile steamers afloat, as well as the ships of war. From a national point of view, therefore, this new canal will be of immense importance, as our ironclads would be able to steam across from channel to channel in a couple of hours, instead of having, as at present, to go round the Land's End. The greatest benefit would also accrue to the trade of South Wales, for, when shipping to London and the Continent, by using this canal a distance of 300 miles would be saved, to say nothing of avoiding the great risks to which vessels are liable while sailing around this part of our coast.—*London Times.*

Trade Mark Infringement.

In the case of Keller *vs.* Goodrich Company, recently decided by the Supreme Court of Indiana, it appeared that the appellee had long been engaged in the manufacture of an article used in dentistry, and had printed on each box containing the same the trade mark "The Akron Dental Rubber." The appellant sold a similar article put up in boxes of a different shape and material from those used by the appellee. Upon these boxes it had printed the words "Non-Secret Dental Vulcanite, made according to our analysis of the Akron Dental Rubber." The words preceding "Akron Dental Rubber" were printed in black ink, but the words "Akron Dental Rubber" were printed in red ink, the type being large, so as to readily and quickly catch the eye. The court held that this constituted an infringement of the appellee's trade mark.

Weakness of Short Columns.

Cast iron pillars with flat ends uniformly bear about three times as much as those of the same dimensions with rounded ends, and this was found by experiment to apply to all pillars from 121 times the diameter down to 30 times. In flat-ended cast iron pillars shorter than this, there was observed to be a falling off in the strength, and the same was found to be the case in pillars of other materials, on which many experiments were made, to ascertain whether the results, as obtained from the cast iron pillars, were general. The cause of the shorter pillars falling off in strength was rendered very probable by the experiments upon wrought iron, for in that metal a pressure of from 10 to 12 tons per square inch produced a change in and reduced the length of short cylinders subjected to it; and about the same pressure per square inch of section, when required to break by flexure a wrought iron pillar with flat ends, produced a similar falling off in strength to that which was experienced when a weight per square inch not widely different from this was required to break a cast iron pillar with flat ends. The fact of cast iron pillars sustaining a marked diminution of their breaking strength by a weight nearly the same as that which produced incipient crushing in wrought iron, and a falling off in strength of wrought iron pillars, rendered it extremely probable that the same cause (incipient crushing or derangement of the parts) produced the same change on both these species of iron. The pressure which produced the change mentioned above in the breaking of cast iron pillars was about one-fourth of that which crushed the materials. I shall therefore assume here that one-fourth of the crushing weight is as great a pressure as these cast iron pillars could be loaded with, without their ultimate strength being decreased by incipient crushing, and that the length of such a pillar, if solid and with flat ends, would be about thirty times its diameter.—*E. Hodgkinson, in the Architect, London.*

18,000 or 20,000 H. P.

The great experiment of the past year has been the Inman and International Company's steamer City of New York. She was intended to make the run to New York in six days. The Etruria has crossed the Atlantic in six days and one hour, but this was an exceptional run, and the average performance of the Etruria is more like six and a half days. Consequently the City of New York must be somewhat faster than the Cunard boats. Up to the present she has failed to attain the expected speed, but she is an extremely fast ship, and it is worth notice that in stormy weather she has twice beaten the Etruria by some hours as a consequence of her great size. The City of New York has been taken off the line for the purpose of undergoing some modifications, which, it is expected, will bring up her speed to the required point.

Calculation shows that certainly not less than 18,000 indicated horse power will be needed to drive the ship at 20 knots an hour. It is possible that more will be needed, because of the way in which the hull has been put together with vertical butt straps outside. Taking, however, as a basis 18,000 horse power, we find that nine boilers have been provided to supply it. These boilers are double-ended, with six furnaces in each; the boilers are about 19 ft. long, and the grates 6 ft. 6 in.; the boilers stand fore and aft, in groups of three; there are in all 54 furnaces. The Etruria, to indicate 14,000 horse power, has 72 furnaces; but she has only compound engines, while the City of New York has triple expansion engines. The area of her grates is approximately 1,250 square feet to produce 18,000 horse power. Then each square foot of grate must represent nearly 15 horse power.

It is a very easy matter to talk of 18,000 or 20,000 horse power; but few people, we think, realize what it means. The following figures may help them to form a conception of what the much despised practical engineer has to do and does. It is more than probable that the White Star boats being built by Messrs. Harland & Woolf will develop 20,000 horse power. At least, so rumor says; for rightly or wrongly, it is asserted that they will have each 12 boilers and 72 furnaces, worked with forced draught on Howden's system. Assuming that the engines will require 18 pounds of steam per horse per hour, then 160 tons of feed water must be pumped into the boilers every hour, and 160 tons of steam will pass through the engines in the same time. In twenty-four hours the feed water will amount to 3,840 tons, occupying 138,240 cubic feet. A tank measuring 52 ft. on the side would hold one day's consumption, or it would fill a length of 493 ft. of a canal 40 ft. wide and 7 ft. deep. Taking the condensing water at thirty times the feed water, it will amount to 4,800 tons per hour—115,200 tons in twenty-four hours; or, for a six days' run across the Atlantic, to not less than 691,200 tons, or 24,883,000 cubic feet. This would fill a cubical tank 295 ft. on the side—a tank into which the biggest church in London, steeple and all, could be put and covered up. The coal consumed will be 400 tons per day, which would fill forty wagons. This will require for its combustion 8,600 tons of air, occupying a space of 222,336,000 cubic feet. It is impossible for the mind to take in the significance of these latter figures. It may help if we say that if this air was supplied to the ship through a pipe 20 ft. in diameter, the air would traverse that pipe at the rate of about 5·6 miles per hour. It will be seen that the circulating pumps and fan engines of such a ship have no sinecure.—*The Engineer.*

The Planning of Foliage.*

There are certain natural principles and forms running through both leaves and flowers; they follow a regular geometrical distribution of parts, and the form of leaf or flower follows naturally from the principle—or, if I may so say, from the anatomy—upon which it is set out. Thus flowers radiate in threes, as the lily; leaves grow in threes from the same point in the stem, and are in perfect harmony with the flower, as the anemone; leaves divide in threes, as in the water avens, clover, and wood sorrel; doubly triple, as in the columbine; and further carried on to the greatest intricacy, as we see in the parsley. Flowers again are cruciform, as in the wallflower; leaves also grow with the same arrangement, as we see in the lilac and the maple. It should be noticed, too, that that arrangement of the leaves in pairs (called "opposite leaved") extends through the whole anatomy of the plant or tree—the leaf buds being formed at the base of the leaves, they also are in pairs; the leaf buds become branches, all of which are arranged to grow in an opposite manner, the same as the leaves.

But there are many accidental circumstances (such as the leaf bud being destroyed by insects) which, in the case of branches, prevent the opposite principle from being too strictly carried out, which, if it were, would give the tree too stiff and formal an appearance. So also in alternate-leaved plants or trees it follows through the whole system, and all the branches are alternate. But to pass on from what I have called the cruciform arrangement. We next come to flowers which are divided into five petals, or set out on the pentagonal principle, and this division is again seen in the leaves. They are first divided into five lobes, with a semi-radiation, simply cut out as in the ivy, divided with deep eyes as in the vine, which we again see in the flower of the hollyhock. The lobes again subdivided, as in the maple and bryony, or separated into distinct leaflets, as in the Virginian creeper, and running again into intricacy in the field geranium and other plants. Then we have the seven lobes in the hollyhock, seven leaflets in the horse chestnut, eight petals in the coreopsis, ten divisions as in the campanula and stellaria, until we arrive at multiplicity in radiation, as we see in the daisy and sunflower and in the leaf of the lupin. Further, we see leaves and flowers take leave of radiation altogether.

Flowers run into a vast variety of forms (far too numerous for me to attempt to go into), such as the pea and bean tribe, and many others. Leaves branch in pairs from a central leaf stalk, as in the elder and rose leaf, which is carried further in the acacia and ash, and is again subdivided and carried into the greatest intricacy in the ferns. In the leaflets of the acacia we see also the heart-shape form which we observed in the petals of the strawberry and the primrose; also again in the violet leaf, but formed the contrary way.

All these facts show that there are certain natural laws, by studying which the artist can produce what form of leaf or flower may best suit his purpose, upon perfectly natural principles, but without following any one leaf or flower in particular, thus giving him such a vast field to work in that there need be no limit to genius or invention.

A Plague of Tigers in Java.

According to the administration report of Java recently laid before the Dutch Chambers, portions of that island are being depopulated through tigers. In 1882, the population of a village in the southwest of the Bantam province was removed and transferred to an island off the coast in consequence of the trouble caused to the people by tigers. These animals have now become an intolerable pest in parts of the same province. The total population is about 600,000, and in 1887, 61 were killed by tigers, and in consequence of the dread existing among the people, it has been proposed to deport the inhabitants of the villages most threatened to other parts of the country where tigers are not so common, and where they can pursue their agricultural occupations with a greater degree of safety. At present they fear to go anywhere near the borders of the forest. The people at present seem disinclined, or they lack the means and courage, to attack and destroy their enemy, although considerable rewards are offered by government for the destruction of beasts of prey. In 1888 the reward for killing a royal tiger was raised to 200 florins. It appears also that the immunity of the tiger is in part due to superstition, for it is considered wrong to kill one unless he attacks first or otherwise does injury. Moreover, guns were always very rare in this particular district, and, since a rising a few years ago, have been taken away by the authorities altogether.

* J. K. Colling, in the *Architect*, London.

© 1889 SCIENTIFIC AMERICAN, INC

SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

The experiment illustrated in Fig. 1 shows the great elasticity of certain solid bodies, and the almost total want of elasticity in other solid bodies. This experiment is introduced here mainly on account of its adaptability to projection with a lantern. A thick plate of glass, a small slab of marble, or better a bar of tempered steel, is supported so that its upper surface appears in the field of the lantern. A small glass ball, or a ⅜ or ½ inch hardened, ground, and polished steel ball, such as is made by the Simonds Manufacturing Company for ball bearings, is dropped upon the glass or steel from a measured height within the field of the lantern. The impact compresses the ball and the plate. At the instant following the stopping of the ball, the ball and the plate, by their own elasticity, return to their normal condition, and the force stored by the impact is given out instantaneously, forcing the ball back toward the point of starting. If undisturbed, the ball will fall and rebound again and again, losing a little of its force each time until it finally comes to rest.

By substituting a lead plate for the glass or steel plate, or by substituting a lead ball for the glass or steel one, it is found that the force acquired by the ball in its descent is expended mainly in changing the form of the plate or ball, and that as the inelastic nature of the material prevents it regaining its former shape, there can be no rebound, as in the other case.

The property of elasticity is also shown by the collision balls illustrated in Fig. 2. This well known ex-

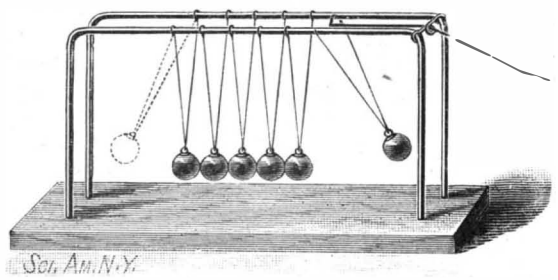


Fig. 2.—COLLISION BALLS.

periment is adapted to the lantern and shows well on the screen. Six of the steel balls already referred to or six small glass balls or marbles are required. Each ball is provided with a small metallic eye, which is attached by means of cement or fusible metal used as a solder. Five of the balls are suspended from the two wire supports by fine silk threads, so that they all hang in line and touch each other very lightly. The sixth ball is suspended by a wire, which is bent down between the supports to receive a thread which extends through an eye attached to the supports and serves to draw back the sixth ball. The thread by which the ball is moved is not noticeable, as it is partly or wholly concealed by the supports. By drawing back this ball in the manner indicated, and then allowing it to fall, its impact will slightly flatten the ball with which it comes into contact, and each ball in turn transmits its momentum to the next, and so on through the entire series. The last of the series is thrown out as indicated in dotted lines, and upon its return its impact produces the same result as that already described, but the effects are in a reverse order.

In Fig. 3 is shown a method of forming magnetic curves for projection, in which the iron particles slowly arrange themselves under the influence of the magnet,

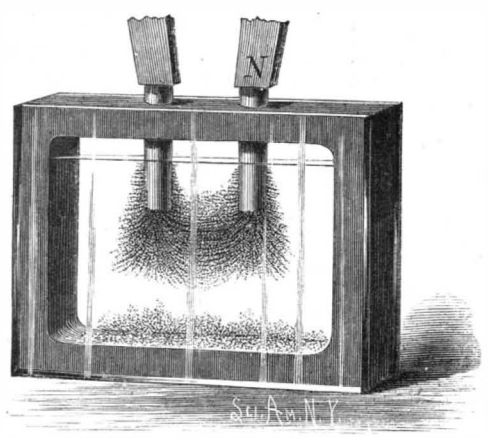


Fig. 3.—MAGNETIC FIELD.

giving the appearance of crystallization. In a closed cell is placed a quantity of glycerine, into which is introduced a quantity of fine iron filings. In the top of the cell are inserted two soft iron pole pieces, arranged to receive the poles of a permanent magnet. The glycerine is thoroughly agitated, so as to distribute the filings as evenly as possible throughout the cell. The cell is then placed in the lantern, and the magnet applied to the pole pieces. The iron particles will be drawn slowly toward the pole pieces, arranging themselves in symmetric curves.

In Fig. 4 is shown apparatus for the projection of the static discharge. It consists of a stand having two vulcanite columns, in the upper ends of which are inserted adjustable brass rods, provided with brass balls at opposite ends. The adjacent balls are adjusted to the striking distance and focused on the screen. The light for projection should be only strong enough to show an image of the balls. When the conductors of a static machine or induction coil are connected with the brass rods, the path of the spark will appear as a brilliant white line on the screen. The discharge of a Leyden jar is still more brilliant.

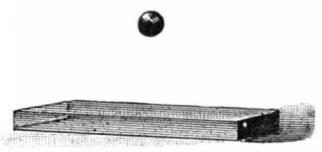


Fig. 1.—ELASTICITY OF SOLID BODIES.

The apparatus shown in Fig. 5 is designed to show upon the screen the experiment known as the electric fountain. A small glass vessel provided with a capillary tubulure at the bottom is supported above a tumbler. The vessel is filled with water and the capillary aperture allows the water to drop slowly when acted upon by gravity only, but when the water is electrified by connection with a static machine or induction coil, it issues in a fine stream, the change in the character of the discharge being caused by the mutual repulsion of the particles of water.

In all these experiments an erecting prism is required.

Changes in the English Patent Law.

The total number of applications for patents in England was larger in the year just completed than ever before, being 19,070, as compared with 18,051 in 1887, or more than three times as numerous as in any year before the passing of the patent act in 1883. That this upward tendency indicates a real amount of industrial progress it would be impossible to deny, though there is, combined with the rise in numbers, a slight fall in the average value of the inventions, as indicated by the smaller proportion which pass beyond the earliest stage. Very little more than half the applications become completed patents, and the percentage has been gradually though slowly declining as the total numbers have increased. Judging from the experience of the previous law, not a quarter of these completed patents will outlast the first period of four years. Under the old system about 30 per cent were not completed, and of those that were completed about 70 per cent dropped at the end of the first stage (then three years).

The principal event during the past year of importance to patentees has been the passing of the patents, designs, and trade marks act, 1888. This is an amending act on the principal act of 1883, and is the result of the recommendations of the Board of Trade Committee on the Patent Office, which, after sitting for two years, reported in January, 1888. This act, which has just been printed, and came into force with the year, establishes for the first time a register of patent agents. The rules by which the practice of patent agents will in future be regulated are to be made and issued by the Board of Trade, the act only providing that from next July no unregistered person shall be allowed to describe himself as a patent agent. The proposal, when it was before the House, met with a certain amount of criticism from the technical papers, but was accepted.

Another provision of importance is the abolition of what are known as "notices of interference." It has hitherto (since the passing of the 1883 act) been the practice for the office to send notice to an applicant of any subsequent application received at the office which appeared to interfere with his, in order to give him an opportunity of opposing the granting of a patent. This provision has never worked satisfactorily, the officials not having been able to make up their minds as to what constituted a "similar invention," and has therefore probably been of little practical value to patentees. The idea of informing inventors that others were on the same track was an excellent one, and the exercise of a little judgment on the part of the officials would have made it useful, and enabled it to have been carried out to the great benefit of the public. As, however, they were incapable of turning the rule to the advantage of inventors, it was perhaps as well that it should be dropped.

The remainder of the act refers principally to designs and trade marks. There is a new definition of a trade mark which does not appear much easier to construe than the old, and there are other modifications of procedure, the result of experience in the working of the act of 1883.—*London Times.*

Coasting without Snow.

Many of the streets of Astoria, Oregon, are as precipitous as those of our rugged New England towns, and furnish ample grades for the prosecution of that old pastime, sliding down hill.

Snow seldom if ever falls, but the climate is so moist that, at the freezing point, nights and mornings, a thick coat of white frost covers the planked roadways, which are turned into extempore toboggan slides. The amusement is so enjoyable that it is kept up into the small hours of the morning by old and young, the speed attained frequently exceeding that of the ordinary railway train.

The Compressibility of Sea Water.

An important contribution was made to the discussion of the subject of the compressibility of sea water, at a recent meeting of the Royal Society of Edinburgh, by Professor Tait, a scientist, says *Engineering*, well entitled to speak on the question by virtue of his experiments to ascertain the effects of the sea pressure on the Challenger deep-sea thermometers. The address, which was given at the request of the council, dealt with the historical as well as experimental phase of the subject. Until about ten years ago little that was positive and complete was known of the properties of water as regards compressibility. Lord Bacon and others had in vain attempted to compress water, but in this case the water was in a metal shell, completely filled, sealed, and exposed to blows with a hammer. Professor Tait said he encountered difficulties in his experiments, and the principal of these was that water got heated by compression much more rapidly when vulcanite was immersed in it than when there was no vulcanite. By means of a galvanometer he showed to what extent the heating was observable. In trying to overcome the difficulty he ascertained the remarkable fact that the heat evolved increased in a greater proportion than the pressure. This, then, established the fact that water is more expansible when the pressure is greater. A practical test with the thermometer at a depth of a mile and a half of sea confirms this fact. Difference in the results attained from those got in the laboratory was due to the differences in the temperatures in which the tests were made. He had therefore confirmed the contentions of Perkins in 1823 that the more water was compressed, the less compressible it

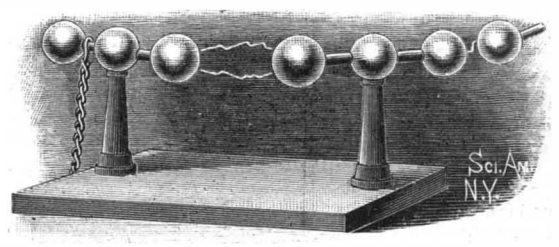


Fig. 4.—PROJECTION OF ELECTRIC SPARK.

became. He also showed theoretically that by the application of infinite pressure water would be compressed to about three-quarters of its natural bulk, but no further. The compressibility of sea water was 0·92 of that of fresh water. The maximum density point of water went down three degrees for every additional ton of pressure applied. Regarding the effect of pressure on the ocean, Canton, 120 years ago, showed that in a depth of two miles of sea the increasing compression of water under the above condition would be diminished by 69 ft.—a statement which Professor Tait had verified. In a depth of six miles the decrease in depth would be 620 ft. If the water of the ocean were to suddenly cease being compressible, the result would be that 4 per cent of the habitable land on the globe would be submerged, because the mean depth of water would be raised by 116 ft.

Henderson Steel.

The experiment of making steel from the pig iron of Alabama at a very reasonable cost has at last been practically solved by the Henderson process. To test the process, during the spring of 1888 a company erected a small furnace, lining it with the best ordinary fire-brick. The result of the iron made was, first, that steel of the finest quality as well as soft steel could be made, but the test demonstrated also that the fire-brick used could not withstand the heat. The company was not discouraged, but doubled its capital to $40,000. With this it imported magnesia brick from Germany, and made a furnace of about 14 tons capacity a day. This new furnace was put into blast on November 26, 1888, and has since been running continuously and without any injury to the magnesia brick. The cost of making the finest steel by this process and by this company, limited as its plant is, will not exceed $22 per ton. Heretofore steel could not be made out of the low grade iron of the Birmingham and St. Louis districts by any process known which did not cost too much; but it looks now as if there would be a great revolution in Southern iron, and also in the steel business of Pennsylvania, as its iron will have energetic competition from Alabama. There is ore and coal enough, however, in the latter State to absorb all the Pennsylvania manufactories which desire to change their base of operation.

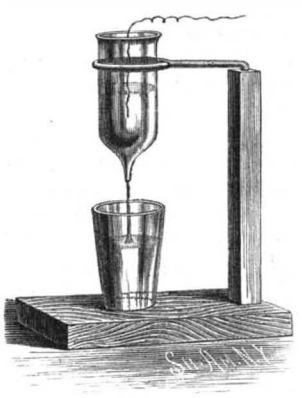


Fig. 5.
ELECTRICAL REPULSION.

© 1889 SCIENTIFIC AMERICAN, INC

RECENTLY PATENTED INVENTIONS.

Engineering.

ELECTRIC STOP VALVE.—Robert Wellens, Pittsburg, Pa. This is an oscillating valve, whose stem has a weighted arm to drop and close the valve, with a catch and electro-magnets for operating it, the magnets being in the circuit of a battery whose wires extend throughout the building, with push buttons for closing contact and operating the valve.

Mechanical.

SEWING MACHINE SHUTTLE.—Charles H. Benoit, San Jose, Cal. The shuttle is enlarged at special points to receive a large bobbin and a large quantity of thread, and is of a form to pass readily through the loop, while in connection therewith a novel form of tension spring is employed.

HOISTING MACHINE.—Volney W. Mason, Providence, R. I. The hoisting drum is mounted upon eccentrics, which are operated by a lever to throw the drum alternately in and out of contact with the driving pulley and the brake shoe, the invention covering novel parts, details, and combinations, making a simple and durable machine designed to be very effective in operation.

STONE SAWING.—Ludwig Melchior and Friedrich Meyer, Wilmington, Del. This invention covers an attachment with cross bar, guides, and clamps of novel form, for machines in which a gang of saws is secured in a reciprocating frame, whereby the saws will be braced and may be operated rapidly and under considerable weight, while causing the saws to make a cleaner cut.

RASP CUTTING MACHINE.—Philip S. Stokes, Tennent, N. J. In this machine springs and cams operate upon two hammers, one preceding the other, in combination with a punch stock and punch held in the anvil frame and pivoted at or about its center, one of the hammers delivering a light blow preceding the heavy blow of the other, whereby the point of each tooth is made perfect and sharp, the invention also covering various other novel details.

LACING DRIVING BELTS.—Geo. W. Southwick, Stamford, Conn. This invention covers an eyelet or re-enforce for the lace holes, consisting of a flat U-shaped metal piece, with prongs formed on its two branches to penetrate the leather back of the eyelet, and a flange on the inner side of the bend, to form a flat bearing at one side of the eyelet hole, to prevent the lacing cord from pulling out the leather.

PRINTERS' GALLEY.—J. Hatfield Youmans, Asbury Park, N. J. This galley has a movable bar or stick therein, in combination with disks or plates pivoted eccentrically to the frame, and with curved slots and pins, whereby the bar or stick will be automatically locked against a standard measurement of type, the device being adaptable by thumb screws for different measurements.

Railway Appliances.

RAIL JOINT.—Ives and Walter T. Lynd, Troy, N. Y. A key plate is constructed to lie lengthwise between the abutting ends of a pair of rails held in a bed plate and an inclined flange of the bed plate, the key plate being wedge-shaped laterally and vertically, whereby the rails may be tightly clamped and held in their bed plate by a lateral and downward pressure of the key plate.

COUPLER ATTACHMENT.—William L. Dwyre, Albany, N. Y. This is a simple device for attachment to the ordinary pin and link car coupler, by which it can be easily set for coupling and uncoupling without the operator going between the cars, and by which it will then couple automatically, the invention covering various novel features of construction and combinations of parts.

Agricultural.

COTTON PICKER.—James W. Wallis, Birmingham, Ala. This machine is an improvement in that class of cotton harvesters in which the pickers or devices for removing the cotton from the bolls have a reciprocating movement, whereby they are caused to swing into and out of the cotton plants, the invention covering various novel features and combinations of parts.

Miscellaneous.

DISINTEGRATING FIBERS.—Sidney S. Boyce, New York City. This invention covers a process of disintegrating fibrous substances, to separate the natural fiber of the straw from gummy and resinous matters, etc., the straw being first broken and subjected to a boiling neutral soapy solution, after which the fibers are dried, rolled, and finished.

BEE HIVE.—Jonathan Beeson and John H. Hirschfeld, Saline City, Ind. This hive is made with a comb chamber having a hopper shaped bottom, formed of inclined boards having a space between them, below which is a section with sirup trough from which the bees may feed, and a reversible section with screen doors for closing the chambers formed by the bottoms, so that rain or snow cannot beat into the hive.

STOPPER FASTENER.—Charles P. Maiser, Allegheny, Pa. This fastener is also designed to serve as a guard to protect the upper edge of a bottle or jar to which it is applied, and consists of a wire bail with eyes or loops, and a cross bar to protect one side of the bottle neck, while a lever, in connection with the stopper and eyes and loops, protects the opposite side.

BOOK SHELF.—John M. D. France, St. Joseph, Mo. This invention covers a casing with metallic horizontal mortises therein, in combination with a sliding board having metallic tongs on its ends, whereby the board will slide in the casing, making an improved shelf for the protection of record books.

TOOTH BRUSH.—William H. Smith, Florence, Mass. This brush is made with a hollow handle, in two parts hinged together and adapted to receive the brush, which is pivoted in one half the handle, whereby the brush may be inclosed when not in use and rendered readily portable.

VEHICLE WHEEL.—Horatio F. Hicks, Ashland, Oregon. Combined with the hub and rim of the wheel are two sections of curved spring spokes, the curves of the two series being oppositely arranged with respect to each other, whereby the spokes will have elasticity enough to yield when the wheel passes over a rough, uneven road.

SLEIGH BRAKE.—William R. Wilcox, Portland, Col. This is a brake which may be put on or taken off by throwing the shaft lever either forward or back with the foot or hand, while it is light and durable, and designed to yield to any obstruction encountered, but yet return to its gripping position, without communicating strain or shock to the operator.

TRICYCLE.—Francis W. Pool, Norwich, Conn. This vehicle has a right and left hand spirally grooved axle, at right angles to which is a rock shaft, while a sleeve loosely holding rings travels upon the axle, the rings having lugs entering the grooves, and a link connects the rock shaft and sleeve, whereby it is designed that the machine may be propelled at a high speed with but little exertion.

NAPHTHALINE PAPER.—Adolph Tsheppe, New York City. This is a paper having a coating of naphthaline in two or more superposed layers, the first presenting a rough appearance, while the second fills up the interstices, presenting a hard, compact, smooth surface, made by immersing paper in melted naphthaline of different temperatures.

FIBER FROM PINE NEEDLES.—William Latimer, Wilmington, N. C. The process of making the fiber is by first briefly boiling in an alkaline solution, then lowering the temperature and slowly digesting the mass for a number of hours, after which the solution is drawn off and the mass washed with pure water by successive steepings and soakings.

SCIENTIFIC AMERICAN BUILDING EDITION.

FEBRUARY NUMBER.—(No. 40.)

TABLE OF CONTENTS.

1. Elegant plate in colors showing elevation in perspective of a suburban club house, with floor plans, sketch of entrance, etc. Munn & Co., architects, New York.
2. Plate in colors showing perspective and plans, with details, for a comfortable country dwelling. Cost three thousand five hundred dollars. Designed by Munn & Co., architects, New York.
3. View of the Jay Gould tomb at Woodlawn cemetery, near New York city. A most classical specimen of mortuary architecture.
4. A residence at Rutherford, N. J. Perspective elevation and floor plans.
5. A Queen Anne cottage at Flatbush, Long Island. Cost complete, eight thousand dollars. Plans and perspective.
6. A carriage house for one thousand dollars, lately built at Flatbush, Long Island. Perspective and floor plan.
7. A house for three thousand dollars lately erected at Bridgeport, Conn. Perspective elevation and floor plans.
8. A residence at Orange, N. J. Cost fourteen thousand dollars. Plans and perspective.
9. A block of eighteen hundred dollar frame dwellings at Syracuse, N. Y. Floor plans and perspective.
10. The Galliera Museum, Paris. Half page engraving.
11. Sketches from the Architectural League Exhibition: Proposed memorial campanile for plaza of Prospect Park, Brooklyn, N. Y., Henry O. Avery, architect—The Washington Hotel, Kansas City, Mo., Bruce Price, architect, N. Y.—Towers of hotel at Big Stone Gap, Va., Brunner & Tryon, architects—District school house at Washington, Conn., Rossiter & Wright, architects.
12. Design for a boat house of moderate cost, by Munn & Co., architects, New York.
13. Page of engravings of country residences.
14. Miscellaneous Contents: Restoration of the Doge's Palace.—The broken timber raft.—Raising columns of St. Isaac's Cathedral, St. Petersburg.—Tarred bricks.—Pompeian houses.—Repairing of a well.—Finish for pine.—Architecture as a profession.—Paintwork.—The National Association of Builders.—How best to light our country homes and resorts, illustrations.—Larch lumber.—The Thomson-Houston motor for street cars.—Hints on plumbing and cellars.—The fatal climate of Panama.—Improved hoist for passenger or freight elevators, illustrated.—Clark's new anti-friction caster, illustrated.—Tool cabinet, illustrated.—Universal bevel protractor, illustrated.—California slate.—Pipe wrench, illustrated.—The "Gorton" boiler, illustrated.

The Scientific American Architects and Builders Edition is issued monthly. $2.50 a year. Single copies, 25 cents. Forty large quarto pages, equal to about two hundred ordinary book pages; forming, practically, a large and splendid MAGAZINE OF ARCHITECTURE, richly adorned with elegant plates in colors and with fine engravings, illustrating the most interesting examples of Modern Architectural Construction and allied subjects.

The Fullness, Richness, Cheapness, and Convenience of this work have won for it the LARGEST CIRCULATION of any Architectural publication in the world. Sold by all newsdealers.

MUNN & CO., PUBLISHERS,
361 Broadway, New York.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

——*Ball Engine.*——

Automatic cut-off. Ball Engine Co., Erie, Pa.

A specialty made of copper forgings for electrical purposes. Steel Wrenches and Eye Bolts, Bronze Forgings. Billings & Spencer Co., Hartford, Conn.

Philip Parsons, Bishopsgate Within, London, solicits agencies for the sale of American goods in England.

Wanted, Toolmaker—Must be experienced in tap and die work. A thoroughly competent man can find steady employment at good wages by addressing "Cleveland," P. O. box 773, New York.

Special facilities for manufacturing light machinery, hardware, and novelties. Stamping, presswork, punches, dies, and special tools. Correspondence invited. Rockaway Manuf. Co., 3 E. 14th St., New York.

Investigate Edson's Recording Steam Gauges, which save coal, etc. Write for pamphlet. J. B. Edson, 86 Liberty St., New York.

Wanted—Assistant superintendent at a chemical works near New York. To a steady, pushing young man, with a knowledge of chemistry and engineering, and some experience with workmen, preference will be given. Address, giving age, experience, and references, "B. C. Co.," P. O. Box 773, New York City.

Patentees and Inventors—Any one having valuable inventions and needing money for developments may obtain funds by stating full particulars and date of patent, to post office box 356, New York.

Air compressor for sale cheap. Also steel tanks, iron rail, cars, etc. Address The Buffalo Wood Vulcanizing Co., Buffalo, N. Y.

For Sale—A complete set of SCIENTIFIC AMERICAN, bound, from 1853 to 1889, and also complete SUPPLEMENTS. Address F. Lankenheimer, Cincinnati, Ohio.

Screw machines, milling machines, and drill presses. E. E. Garvin & Co., 139-143 Center St., New York.

For the latest improved diamond prospecting drills, address the M. C. Bullock Mfg. Co., Chicago, Ill.

For the best Hoisting Engine for all kinds of work, address J. S. Mundy, Newark, N. J.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Perforated metals of all kinds for all purposes. The Robert Aitchison Perforated Metal Co., Chicago, Ill.

The Holly Manufacturing Co., of Lockport, N. Y., will send their pamphlet, describing water works machinery, and containing reports of tests, on application.

Planing and Matching Machines. All kinds Wood Working Machinery. C. B. Rogers & Co., Norwich, Conn.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Friction Clutch Pulleys. The D. Frisbie Co., N.Y. city.

Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N.Y. See illus. adv., p. 28.

Rotary veneer basket and fruit package machinery. I. E. Merritt Co., Lockport, N. Y.

Belting.—A good lot of second hand belting for sale cheap. Samuel Roberts, 369 Pearl St., New York.

The Star Fountain Gold Pen. The best made stylo. Price, $1.00; fountain, $1.50 and up. Send for circulars. J. C. Ullrich & Co., 106 Liberty St., New York.

Duplex Steam Pumps. Volker & Felthousen Co., Buffalo, N. Y.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(368) T. H. T. writes: Two years ago I had a present of a very fine cane with a buck-horn handle. From constant use, the white part of the handle became dirty, and after trying several methods to clean it, scraped it with a knife, which of course made it look worse than ever in a few weeks. A. A very perfect surface is given by scraping; the scraper may be of a razor blade, the edge of which should be rubbed upon an oil stone, holding the blade nearly upright, so as to form an edge like that of a currier's knife, and which, like it, may be sharpened by burnishing. Work, when properly scraped, is prepared for polishing. To effect this, it is first to be rubbed with a buff made of woolen cloth *perfectly free from grease;* the cloth may be fixed upon a stick, to be used by hand; but what the workmen call a *bob*, which is a wheel running in the lathe, and covered with the cloth, is much to be preferred, on account of the rapidity of the operation. The buff is to be covered either with powdered charcoal and water, or fine brick dust and water; after the work has been made as smooth as possible with this, it is followed by another buff, or *bob*, on which washed chalk or dry whiting is rubbed; the article to be polished is moistened slightly with vinegar, and the buff and whiting will produce a fine gloss, which may be completed by rubbing it with the palm of the hand and a small portion of dry whiting or rotten stone.

(369) P. H. W. asks: If the compact battery described in SCIENTIFIC AMERICAN of September 3, 1881, would be suitable for the simple electric motor, and if so, please designate the number of couples or cells that would be required? A. Yes. Use ten to twenty cells.

(370) J. C. W. asks: What kind, size, and amount of wire should I use in making electro-magnets? A. We refer you for a very full article on electro-magnets to SCIENTIFIC AMERICAN SUPPLEMENT, No. 182. The size and amount of wire depends on your requirements.

(371) D. & H. ask if it would injure a watch in any way to ride on an electric motor street car? A. It may injure it, but probably will not.

(372) G. B. writes: The fishermen of this city are discussing the question, "Does water form ice on the top or on the bottom?" and cannot agree. A. Ice forms on the surface of water. Fine crystals may form and be carried down by currents and eddies, so as to become packed together into a solid mass at or near the bottom, but water forms ice on the top.

(373) W. W. V. writes: 1. In making an electro motor like the one described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 641, but only one-half the dimensions, what size wire should I use on armature and field, when the motor is to be run by gravity battery? A. Use wire three or four numbers smaller than specified for regular size. 2. How many cells of 5 × 7 crow-foot battery will be needed, and how coupled? A. The gravity battery is entirely unsuited for such work, owing to its high resistance. You will find suitable batteries described in the SCIENTIFIC AMERICAN of September 3, 1881; August 20 and December 17, 1887; and a good method of making carbon plates, issue of October 27, 1888. Use six or eight cells of large bichromate battery, or thirty of gravity arranged in five series. 3. Could soft iron wire be used for field magnets instead of sheet iron? A. Yes. 4. Does a person making a patented article for his own use infringe on the patent? And is he liable to prosecution? A. You have no right to do this, and will infringe, and be liable to prosecution if you do. 5. Would ordinary glass fruit jars do to make Leyden jars out of? A. It is doubtful, as some cheap glass is a very poor dielectric. You can determine its quality by testing it roughly for insulation.

(374) "Gold" writes: 1. I tried etching on 14 carat gold, which was rolled on silver, using muriatic acid two parts, nitric one part, and three parts of water. It etched a very little, and then a black skin seemed to spread over the unprotected gold, and it would not etch any farther. Could you explain it? A. The acid dissolved the gold, but refused to dissolve the silver, as the latter metal forms an insoluble chloride in the presence of muriatic acid, or refuses to dissolve at all. After the mixed acids act no longer, wash the metal and treat with nitric acid, when the silver will be dissolved. The acid will probably under-cut the gold. You cannot dissolve gold and silver by the same acid. Cyanide of potassium, especially if assisted by the battery, might answer your purpose. 2. Do you know of any book which treats of the action of different acids and chemicals on metals? A. Manuals of chemistry contain this information scattered through them. We can supply any you desire.

(375) F. W. asks: 1. How can indelible ink be removed from linen? A. Chloride of mercury is the best eradicator of indelible ink. 2. What size wire to wind fields and armature with, of the small dynamo described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 161, so it can be run as a motor from an Edison incandescent circuit, 110 volts; want to run from an Edison lamp socket. A. For motor see SUPPLEMENT, No. 641, which we can send you for 10 cents. Place in shunt; do not attempt to use a full Edison current on it. 3. Would the above motor run a sewing machine? A. The simple motor would run a sewing machine.

(376) A. B. M. writes: Will you inform me of the ingredients used, and how applied to canvas, as prepared by manufacturers for artist's use? A. Size it first with thin glue size, then apply moderately thick white lead paint with a palette knife and allow to dry.

(377) J. P. M. asks for a conductor for an electric current that will stand in cyanide of potassium; he often has articles to spot gild, and has been unable to find anything that would resist corrosion. A. We recommend lead wire; this will be little affected by a true cyanide solution.

(378) C. E. E. says: Will you please tell me what the liquid is that is used with bronze powder? A. Try ½ lb. linseed oil, mixed with 2 oz. gum animi, the latter powdered and gradually added to the heated oil; then boil, strain, and dilute with turpentine.

(379) T. L. C. writes: Please tell us the precise time from new moon to new moon, or is there any regular time? Comstock's Philosophy says 29 days 12 hours and 44 minutes, but almanacs differ as much as three hours. A. The mean solar revolution of the moon is 29 days 12 hours and 44 minutes. The ellipticity of its orbit makes a variation of nearly one hour. The time of new moon also varies with the geographical distances in longitude from the meridian at the moment of the new moon. For instance, if new moon should take place at the meridian of Washington at noon, all places west would have morning time, and all places east would have afternoon time, according to their difference of longitude, allowing one hour for each 15 degrees; to which a correction must be made for the moon's orbital variation.

(380) L. F. L. asks: 1. How to filter wintergreen, cedar, and like essential oils to effectually cleanse them? And how to reclean the filter without a waste of oil? A. You may use any filtering material, such as cotton wool, and wash it out afterward with benzine. You will inevitably lose some of the oil, unless it is a non-volatile oil, when it can be recovered. If volatile, you may save most of it by forcing steam through the filter. 2. Is there such an oil as laurel oil? If so, is it an expensive oil? And what is it used for?

© 1889 SCIENTIFIC AMERICAN, INC

A. There are several laurel oils: one is made by distilling with water the berries of the sweet laurel (*Laurus nobilis*); the product is often called bay oil, and is used for making toilet preparations. It is expensive. The specimen you speak of did not reach us with your letter. 3. What effectual means can I use to cleanse a flue which cannot be reached by a sweeper? Have always burnt wood. A. Explode a small amount of gunpowder at the bottom, and if there is danger of the chimney catching fire, burn a little sulphur held well within it.

(381) A. K. asks how to make the modeling wax that is used by artists. A. Melt carefully 100 parts yellow wax, add 13 parts Venetian turpentine, 6½ parts lard, and 72½ parts elutriated bole or other inert powder; mix thoroughly, pour off, and knead as it cools. The wax must be melted at a low temperature.

(382) W. C. B. writes: Please inform me how to find the exact focus of my camera lens. The focus of a camera lens and the distance from that lens to the object to be photographed being known, is there any rule by which I can tell what distance the negative plate should be from the lens, thereby substituting instrumental focusing for visual focusing? A. The focus of a camera lens depends upon the distance of the object from the camera, there being an exact focus for every given distance. If the camera has a solid box or a fixed position for the plate, the focus can be adjusted for varying distances and marked upon the slide. This would be reliable for the distance, but would not take in the variation for effect with various kinds of objects, as between landscapes and portraits or other objects. In portraiture there is a little variation required for different faces that the eye only can appreciate. We do not think that index focusing will give the best results, except for copying, by which the focus and distance of the object become exact exponents.

(383) F. D. P. writes: I inclose herewith a problem for your correspondence column. It was given by a man at our school and there was quite a diversity of opinion in regard to it. A solution from you will greatly oblige. I would also like a little information on another matter which I also inclose. Have been greatly entertained by some of the questions in your paper. 1. A tank 10 feet inside diameter, 232 feet high, made of 4 inch staves, is hooped with 6 inch iron hoops 12 inches apart. What is the pressure per square inch on third hoop from bottom, allowing 2·03 feet to equal one pound? A. The pressure against the sides of the tank at the third hoop is equal to 230 feet hydrostatic pressure, or 100 pounds per square inch. To get the pressure or strain on the third hoop, multiply the pressure by one-half the diameter in inches, which we make 6,000 pounds for one inch height. Now, as you say that the hoops are 1 foot apart and 6 inches wide, this makes 18 inches in height between the centers of the spaces for each hoop to hold—6,000×18=108,000 pounds strain upon the hoop. Now if the hoops are half an inch thick, there will be but three square inches of metal, and as iron hoops should not be trusted for more than 20,000 to the square inch in any case, you have 3×20,000=60,000 pounds safe resistance against 108,000 pounds strain. Such a tank could not be filled with safety. 2. What metal possesses the quality of expanding and contracting in the greatest degree with temperature from 40° to 80° Fah.? A. Zinc has the greatest range of expansion and contraction of the solid metals, being eight-tenths of an inch in 100 feet for a difference of 40° Fah. 3. How much does an iron rod ½ inch by ¼ inch, 2 feet long, expand in length for a change of temperature from 40° to 80° Fah.? A. For the iron rod 2 feet long, the change of length would be equal to 64 ten thousandths of an inch for a change of temperature of 40° Fah.

(384) W. L. S. writes: Please state through the columns of your paper. 1. The cause of shooting stars and velocity of same. A. You will find complete illustrated articles on meteors or shooting stars—history, theory, speed, and distances, as far as known—in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 532 and 667. 2. The simplest way of boring a hole in glass, excluding the use of a drill? A. The simplest and safest way to bore holes in glass is to use a copper or brass tube, quite thin, of the size of the hole. Bore a hole in a small block of wood about ¼ inch thick. Hole to fit the tube loosely. Fasten the block to the glass with beeswax, so that the hole corresponds with the required hole in the glass. Insert the tube in the hole and pour emery (No. 90) and water into the tube with a spoon and turn the tube back and forth with the fingers, or a little grooved pulley may be put on the tube to work with a string, in which case a center should be placed at upper end to guide the tube. In this way a hole of any size from ⅛ inch to an inch or more may be cut through ordinary window glass in a few minutes.

(385) J. B., Fire Department, writes: Will you please answer the following: What should be the size of the steam ports for whistles with cylinders 9 inches by 18 inches, 6 inches by 18 inches, 6 inches by 24 inches, pressure 60 to 80 pounds? Must ports be increased according to size of cylinder? What distance should cylinder be from port to give a deep vibrating tone? Should port be exactly the same diameter as the inside of cylinder? Are whistles sounded any other way than a circular groove or port? If so, which gives best results for fire alarm? A. The opening in the ports of steam whistles of cylindrical form or bell for the sizes above should be one thirty-second of an inch for the 6 inch cylinders and a sixty-fourth of an inch wider for a 9 inch whistle, for the above pressure. As a general rule, the ports should increase in width with the diameter of the cylinder and be made of the same diameter as inside of cylinder or bell. The thickness and length of the bell controls the tone and the distance of the edge of the bell from the ports generally fixes the volume of tone. The distance of the rim from the ports is adjustable, and may vary from 1½ to 2½ inches in large whistles, and is the only adjustment in the hands of the engineer for bringing out the full volume to meet variable pressures of steam and any imperfection of the workmen in sizing the ports. The cylindrical whistles with annular ports are the most powerful and compact, and are in general use.

(386) G. F. M. writes: Please inform us, through your valuable paper, the most economical lacquer for chandelier work. What is the best mixture to apply to the ends of metal spinners' wooden chucks to keep them for cracking? A. Lacquers are generally made with shellac and alcohol, with a little gum coloring from dragon's blood or turmeric. See "Techno-Chemical Receipt Book," which has a variety of receipts or processes for lacquering, varnishing, and bronzing of metals. We can mail it for the price, $2.00. Chucks for spinning should be thoroughly seasoned before use. Dipping in hot linseed oil and drying in a warm oven after the chuck has been shaped may answer your purpose.

(387) E. J. S. asks (1) for the component parts of the Disque Leclanche battery. A. The porous cup contains a carbon prism embedded in clear graphite and binoxide of manganese mixed in about equal parts. The outer cell contains an unamalgamated zinc rod. Sal-ammoniac dissolved in water is the exciting fluid. 2. How to make a battery of uncoppered electric light carbons, using sal-ammoniac for the exciting fluid? A. See SCIENTIFIC AMERICAN, December 17, 1887, and October 27, 1888. 3. How to make an electric gas lighting coil for two or three burners? A. Wind 5 pounds No. 18 wire on a bundle of iron wires, the bundle to be 6 inches long and 1 inch thick. 4. What kind of battery is best to use in connection with it? A. A Leclanche battery is excellent or the battery shown in first named SCIENTIFIC AMERICAN, using only one zinc rod, and using sal-ammoniac and water as the solution.

(388) P. W. W. asks for the ingredients used in the making of British gum. A. British gum or dextrine is prepared by the artificial roasting of dry starch at a temperature between 413° and 482° Fah. It is also made by an acid process, in which the dry starch is moistened with dilute nitric or hydrochloric acid and heated to a temperature between 212° and 248° Fah., and may also be made direct from potatoes. For the illustrated details of its manufacture see Spons' "Encyclopedia of the Industrial Arts."

(389) E. F. L. writes: Please give a simple and practical way to purify resin and precipitate its impurities. A. Melt and allow to settle, and if necessary, strain through sacking.

(390) P. L. M. writes: I am in search of a recipe to make what is called "compressed Chinese sheet bluing." It is a very nice article of bluing, that is sold to families by agents in small sheets of about the size of playing cards. A. The preparation may be paper saturated with a strong solution of Prussian blue in water containing ferrocyanide of potassium.

(391) A. H. S. writes: What can I use to rub upon or cover a bony substance so that it will become a conductor of electricity, that will enable me to plate it with gold, silver, or nickel, etc., so that it will adhere to the surface with tenacity and durability? A. Coat it with plumbago of good quality, applying it with a brush, as polishing a stone. The adherence to the surface will not be very great, but the model, if under cut, will hold it with great tenacity.

(392) G. E. W. asks for the surface of the zinc and copper and the number of cells of gravity sufficient to run a Sawyer-Man 19 volt 12 candle power incandescent lamp. A. Use carbon zinc couples excited by electropoion (bichromate and sulphuric acid) fluid. Twenty cells, each having eight square inches of zinc and copper facing each other, will answer.

(393) D. E. W. asks how to prepare the surface of glass so that it may be drawn on with India ink (the purpose being to make lantern slides). A. Try the following: Shake white of egg with twice its volume of water, and ten drops of ammonia, pour off the froth, and flow the plate with the clear solution and allow to dry, and heat slightly in an oven. Mix a little ox gall with your pigment. You can use thick India ink directly upon the glass.

(394) R. H. S. asks: Please tell me how to construct a glass melting apparatus, such as is used by amateur glass blowers. A. We refer you to Shenstone on Glass Blowing, which we can supply for 80 cents, for full description of glass blowing processes.

(395) B. A. asks: 1. What preparation would be the best to fasten cue tips to cues? A. Use carpenter's glue. 2. Please let me also know the way to make pool balls. A. The best are turned out of ivory, various compositions are used for inferior ones, into which celluloid or analogous substances enter. 3. The balls I now have are more or less disfigured by use. Will you please let me know what compound I can use to repair them? A. Have them turned down. We doubt if you can repair them.

(396) G. I. writes: Can you tell me through your paper how water can be sucked up a hill, 50 or 60 rods long with an elevation of 60 feet by the use of a windmill, without triangles and have the mill above the spring? A. You cannot draw the water higher than from 20 to 25 feet with certainty. You may place a windmill and pump above the spring so as not to lift over 25 feet and force the water to the required height. This, with a windmill of moderate height, should give a fair working power for ordinary uses, and is preferable to the bell crank connections for any considerable distance.

(397) A. G., Patras, Greece, writes: As a subscriber I take the liberty of asking you to reply through the columns of your paper as to which is the best method of polishing hippopotamus hide? I have a strip of the said hide which I wish to convert into a riding switch, and am told that it admits of a very high polish. A. Hippopotamus hide, if tanned, can be polished by preparing the surface by planing or cutting to the required shape and scraping with broken glass, so as to obtain as smooth and fine surface as possible. Then rub the surface with paraffine and polish with a woolen cloth or wool buff.

(398) E. U. asks: Can you give me directions for making porous cups for battery purposes? A. They are made of porous clay, baked in a kiln. You may have to mix a little sand with the clay to prevent it from cracking, and you should have enough heat in an ordinary stove for firing them.

(399) J. J. B. asks (1) if the motor described in your paper can be made so as to run by a Westinghouse alternating current. If so, please inform me what change should be made? A. It is not adapted. 2. What is the easiest way to make a storage battery? A. There is no easy way. Consult our index to SUPPLEMENTS. 3. Can the field magnet in the motor be cast out of brass? A. No.

(400) M. A. N. asks: How many Bunsen cells would be required to produce a light to study by, and illuminate a room 14 ft. square? What would be the cost of getting cells and light ready and the running expenses? A. Twenty or thirty quart cells; they will cost about $1.50 each; the lamps and connections, $2; they will cost to run not far from 25 cents an hour.

(401) H. E. M. asks: Does resistance of wire decrease the number of volts or amperes of current? A. It decreases the amperes only, and does not necessarily affect the volts.

(402) Inquirer writes: 1. Will a current of electricity instantly applied to and instantly broken from a very tightly stretched wire make it vibrate enough to produce sound? A. No. 2. Can it be said of a battery that it collects electricity or that it sets it free by chemical action? A. The second statement approaches the truth. In a battery, chemical energy is transformed into electric energy. 3. Is the present open winter accounted for upon any astronomical basis? If so, what is it, and how does it affect the earth's atmosphere? A. No tangible basis can be assigned.

Enquiries to be Answered.

The following enquiries have been sent in by some of our subscribers, and doubtless others of our readers will take pleasure in answering them. The *number* of the enquiry should head the reply.

(403) T. H. DeS. writes: 1. Is a steam radiator more effective under 15 pounds of steam than under, say 2 pounds, or is the temperature of the radiator unaffected by the rise in the temperature of the steam due to the increased pressure? I have seen it stated that the pipes of a radiator could not be made hotter than 212°, and cannot help thinking that it must be a mistake. 2. What is the relative efficiency of the following coals for making steam under the ordinary return tubular boiler, without blast? (*a*) The bituminous coal mined from Jelico Mountain, Tenn., having streaks of cannel through it occasionally. (*b*) Pure cannel mined in North Alabama. (*c*) Semi-cannel mined in North Alabama. (*d*) Semi-anthracite mined in North Alabama. If you are not familiar with these special coals, give values generally, based upon the kinds of coals named. 3. For deep well pumping, which is the best, in your judgment, to have, a vertical steam cylinder, etc., such as Knowles steam pump works make, and the Deanes also, placed over the mill with the piston rod in direct connection with the sucker rods, or to have an ordinary horizontal engine with a small pulley on a shaft belted to a large wheel, pulley say 8 feet in diameter, having a crank pin 2 feet from center, said crank pin to be connected to the sucker rods through a cross head and connecting rod? Which will work the smoothest over the ends of the stroke? 4. Will bones thrown in the retort with coal enrich the candle power of gas? If so, why?

(404) H. R. writes: 1. What is the rule for estimating the horse power of water powers? 2. Which will last the longer, a post set top or butt down? 3. With bark on or off, dry or green? 4. What is the difference in the lasting of posts charred and uncharred? 5. Does the time of year in which a post is cut make any difference in its lasting qualities?

(405) C. A. A. writes: Is water collected from a galvanized iron roof in a cistern safe to use for drinking, and is it safe to use galvanized pipes to convey drinking water? Which makes the best roof, tin or galvanized iron? Will water from a painted roof be fit and safe for drinking?

NEW BOOKS AND PUBLICATIONS.

LES INDUSTRIES D'AMATEURS. Le Papier et la Toile. La Terre, pa Cire, le Verre et la Porcelaine. Le Bois, les Metaux. By Henry de Graffigny. 395 drawings. Bailliere et Fils, Paris.

A field which seems to be expanding more and more and which is constantly growing in popularity is the subject of amateur mechanics. Every few months brings out some new work on the subject. It is a refreshing symptom that there are large classes whose recreations are improving in their nature and who find that labor and pleasure may be combined. The above work, which is in French, is the latest production of this character. It treats of the various subjects mentioned in the sub-title. For instance, under the head paper it treats of filtering and tracing paper, impermeable and luminous paper and the methods of preparing them. Then it shows a number of toys, boxes, etc., that may be made of paper. Then the subject of binding is taken up. Then paper flowers, kites, and fireworks made of paper are treated of. The other subjects mentioned are treated in the same manner, the course taken being the steps necessary in progressing from the simplest to more advanced stages of the arts.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

February 5, 1889,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Agricultural heater, C. A. Masterson 397,195
Armature for dynamo-electric machines, O. B. Shallenberger 397,392
Ash or garbage can, McKeever & Smith. 397,301
Atomizer, A. M. Shurtleff 397,315
Automaton, W. G. Spiegel 397,398
Axle box, car, W. E. Heffner 397,233
Ax poll, W. C. Kelly 397,368
Ax polls, die for making, W. C. Kelly 397,369
Axle, wagon, N. S. Ketchum 397,131
Bag. See Paper bag.
Bag holder, B. F. Ellis 397,346
Baling press, H. N. Smades 397,393
Balls, machine for winding, H. Harwood 397,362
Bark from timber, machine for removing, N. H. Dolsen 397,114
Barrel, I. J. W. Adams 397,325
Barrow, double deck, W. H. Hall 397,358
Baseball winding and rolling machine, B. B. Newell 397,303
Battery. See Galvanic battery. Secondary battery.
Bed bottom, spring, E. Yeoman 397,324
Bed, folding, J. Penney 397,308
Bed or upholstered springs, spring, C. B. Howell 397,234
Bedstead, folding, W. J. Griebel 397,183
Bedstead, folding, J. Penney 397,307
Bell, signal, E. Olsen 397,245
Belts, lace hole protector for driving, G. W. Southwick 397,252
Bicycles from a single blank, forming backbones and rear forks of, G. T. Warwick 397,405
Binder shifting mechanism, J. A. Graham 397,356
Bit. See Bridle bit.
Blasting, Plom & D'Andrimont 397,440
Block. See Hat block.
Board. See Bulletin board. Drawing board. Embalming board. Vehicle dash board. Washboard.
Boat. See Racing boat.
Boiler. See Steam boiler.
Boiler tube plug, E. W. Tucker 397,450
Boot or shoe sole protector, E. & D. J. Rowlands 397,250
Bottle stopper, J. A. Traut 397,449
Box. See Axle box. Salt box. Telephone call box.
Boxes, etc., art of and machine for making, M. Young 397,162
Boxes, means for securing metallic bands to, J. H. Williams 397,262
Braiding machines, racer for, J. A. Turner 397,153
Brake. See Sled brake.
Brake, O. L. Gilbert 397,120
Bridle bit, safety, L. P. Britt 397,273
Broom corn, utilizing waste, S. M. Youngjohn 397,482
Bulletin board and broom holder, combined, M. W. Mahar 397,465
Burial apparatus, G. L. Gehring 397,283
Button, D. P. Fitzgerald 397,350
Buttonhole cutter, E. Nowill 397,438
Button setting implement, F. H. Richards 397,388, 397,471
Camera. See Photographic camera.
Can. See Ash or garbage can.
Can jacket, W. Zinsser, Jr 397,163
Car coupling, D. C. Bassett 397,412
Car coupling, E. N. Colwell 397,277
Car coupling, H. H. Mansfield 397,375
Car coupling, S. P. Mickey 397,137
Car coupling, J. H. Simpson 397,413
Car door, freight, E. H. Whitaker 397,322
Car floor, W. L. Everit 397,420
Car heating apparatus, railway, H. R. Towne 397,152
Car heating apparatus, railway, F. M. Wilder 397,161
Car heating apparatus, railway passenger, M. Wood 397,212
Car starter, Ackers & Lindsey, Jr 397,327
Car starter, N. V. Viele 397,158
Car, stock, J. Montgomery 397,199
Car, unloader, H. M. Barnhart 397,165
Car wheels, device for lubricating, S. M. Briggs 397,168
Cars, spring buffer for railway, C. A. Schroyer 397,312
Card clothing, foundation of, S. Roberts 397,441
Card clothing to flat bars, apparatus for attaching, G. & E. Ashworth 397,267
Carding engine cylinders, means for driving, G. & E. Ashworth 397,268
Carding engines, device for securing card clothing to the flats of, G. & E. Ashworth 397,265
Carding engines, doffer comb head for, G. & E. Ashworth 397,266
Carrier. See Cash carrier.
Carpet sweeper, Ru Ton & Gore 397,204
Cart spring, road, R. E. Jones 397,236
Cartridge reloading implement, H. Fuermann 397,421
Case. See Piano case. Shipping case.
Cash carrier, T. M. Kenney 397,237
Cash carrier apparatus, pneumatic, J. L. Given 397,354
Casks, bushing casing for, P. J. Westphal 397,261
Cement, manufacture of, R. W. Lesley 397,373
Chairs, spring attachment for rocking, W. I. Bunker 397,274
Chopper. See Cotton chopper.
Christmas trees, etc., stand for, T. B. Osborne 397,305
Cigar bunching machine, J. E. Smith 397,396
Clamp. See Colter clamp.
Clips for connecting tie bars with switch rails, manufacture of, A. A. Strom 397,447
Clock, advertising, A. V. Strait 397,148
Clutch mechanism, C. A. King 397,238
Cock, stop, E. E. & L. C. Beauvalet 397,332
Coke oven front, E. H. Bradley 397,107
Collar, garment, C. F. Henning 397,289
Collar stuffing machine, G. E. Hoyt 397,292
Colter clamp, R. A. Moore 397,138
Confectioner's use, lace for, J. R. Stout 397,446
Contact and switch, overhead, C. J. Van Depoele 397,451
Cords and tying strips of sheet metal, tool or instrument for cutting, G. Hiller 397,290
Corpses, preserving, J. G. Meyers 397,379
Corset stay, R. Theiler 397,401
Cotton chopper, scraper, and harrow, J. M. P. Lyon 397,133
Cotton picker, J. W. Wallis 397,209
Cover fastener, G. Staib 397,207

© 1889 SCIENTIFIC AMERICAN, INC

Countersink, A. Leitelt 397,483
Coupling. See Car coupling. Hame and tug coupling. Hose coupling. Pipe coupling. Thill coupling.
Crank for machinery, W. H. Kaye 397,367
Cuff fastener, H. C. Frank 397,119
Cultivator, J. B. Himes 397,185
Cultivator, E. H. Spencer 397,253
Cultivator, T. S. Warner 397,404
Cultivator attachment, B. Wagner 397,403
Cup. See Oil cup.
Curtain ring, J. Day 397,419
Cut-off and governor, E. Hartung 397,361
Cut-off for cistern pipes, automatic, E. Cawthorne 397,416
Cutter. See Buttonhole cutter.
Cutting apparatus, endless, A. Clark *et al* 397,224
Dental engine, J. S. Campbell 397,169
Dental plates by electro-deposition, making, J. G. Ward 397,320
Direct-acting engine, G. A. Barth 397,166
Dolls and busts, manufacturing, J. Kubelka 397,463
Door check, B. A. Mitchell, Jr 397,380
Door check, pneumatic, R. Adams 397,326
Door mat, S. Toffler 397,402
Draught equalizer, J. R. Davis 397,343
Draught regulator, automatic, G. E. Dixon 397,173
Drawing board and mechanical ruler, rotatable, C. Sperry 397,147
Drawing board or table, T. C. Henley 397,427
Drilling machine, F. Schoff 397,311
Dumbwaiters, mechanism for operating, G. M. Emerick 397,228
Dyeing machine, T. Wolstenholme 397,481
Dynamite, preparing, G. E. F. Grune 397,285
Dynamo, R. L. Cohen 397,340
Earring, L. Krug 397,433
Electric communicating system, A. G. Holcombe. 397,364
Electric converter, L. Gutmann 397,461
Electric light and other electrical devices, switch and cut-out for, O. S. Bussmann 397,109
Electric machine and motor, dynamo, F. J. Patten 397,439
Electric wire conduit, W. B. Mack 397,300
Electrical circuits, connection of, Griscom & Wiedner 397,424
Electrical conductors, junction box for, W. M. Callender 397,221
Electrical instruments, protector for, J. E. Crandall 397,418
Electrode, therapeutical, L. T. Stanley 397,474
Electrodes, forming secondary battery, R. M. Hunter 397,235
Elevators, etc., grip device for, W. E. Nickerson .. 397,382
Embalming board, L. K. Smedes 397,394
Engine. See Dental engine. Direct-acting engine. Road engine. Steam engine.
Engine crosshead, steam, J. J. Tonkin 397,318
Engine lubricating device, A. L. Ide 397,293
Envelope opener, J. Bird 397,333
Exercising apparatus, R. Reach 397,386
Exercising machine, G. Gaertner 397,352
Extractor. See Fruit juice extractor.
Eyes, machine for forming interlocking, R. Faries 397,175
Faucet, C. O. Maddox 397,374
Fence, J. B. Cleaveland 397,110
Fence, J. C. Kemp 397,370
Fiber from pine needles, making, W. Latimer 397,240
Fibers or yarns, treating, W. J. Williams 397,409
Finger pull, coin controlled, F. R. White 397,160
Fishing reel, A. F. & W. Meisselbach 397,198
Flour, machine for packing, S. T. Ayres 397,411
Foods, preparation of peptonized, D. W. Chapman 397,222
Frame plates for rolling stock, apparatus for the manufacture of, S. Fox 397,178
Frame plates for rolling stock, manufacture of, S. Fox 397,177
Frame plates, manufacturing, S. Fox 397,179
Fruit gatherer, W. S. Brooks 397,334
Fruit juice extractor, J. A. Neichter 397,467
Furnace. See Hot air furnace. Open hearth furnace. Smoke consuming furnace.
Furnace, J. F. Durham 397,174
Furnaces and like structures, device for protecting, McClure & Phillips 397,376
Gauge. See Micrometer gauge. Stone sawing machine gauge.
Galley, self-locking, J. H. Youmans 397,264
Galvanic battery, E. J. Colby 397,111
Galvanic battery, C. E. Egan 397,116
Gas, apparatus for the manufacture of, R. H. Smith 397,397
Gas machine, E. D. Self 397,205
Gasoline apparatus for illuminating and heating purposes, J. Stubbers 397,255
Gate, E. H. Bauer 397,216
Glass mould, S. Hipkins, Jr 397,186
Goods, machine for compressing and bundling, W. O. Crain 397,457
Grading machine, road, J. M. Holland 397,291
Grain binders, knot tier for, J. A. Graham 397,355
Grinding mill, H. F. Stone 397,445
Gun, magazine, H. A. Pitcher 397,143
Guns, loading apparatus for turret, H. Schneider. 397,310
Hair crimper and curler, R. W. Weldon 397,159
Hair pin, W. E. Banta 397,164
Hame and tug coupling, J. Gray 397,182
Harrow, O. Lunn 397,138
Harrow, M. Skow 397,145
Harrow and roller, A. H. & J. H. Davis 397,342
Hat block, J. C. Fiester 397,117
Hatchway, elevator, C. A. McAllister 397,197
Hay carrier track, M. G. Grosscup 397,124
Hay press, W. S. Champion 397,338
Hay press, T. T. Mayes 397,196
Hay rakes, tooth for horse, E. Tush 397,155
Hay stacker, O. H. King 397,431
Heater. See Agricultural heater.
Hinge, spring, J. Keene 397,190
Hoisting machine, V. W. Mason 397,243
Holder. See Bag holder. Strainer holder. Telephone paper pad holder.
Hook. See Whiffletree hook.
Hook, C. S. Van Wagoner 397,157
Horse power, D. Berlew 397,219
Hose coupling, Holton & Britton 397,187
Hose pipe, E. H. Crosby 397,171
Hose strap, I. Glauber 397,180
Hot air furnace, L. W. Turner 397,154
Hydrant, E. Zwiebel 397,213
Hydrocarbons, apparatus for burning, J. H. Bullard 397,336, 397,337
Implement joint, F. H. Richards 397,389
Indicator. See Letter box indicator. Speed indicator.
Ink and color slab, Indian, E. G. Soltmann 397,146
Inkstand, S. G. Baldwin 397,330
Iron, apparatus for converting cast, L. Ianke 397,365
Jar cover, slop, F. Haberman 397,425
Jewelry setting, L. Krug 397,434
Joint. See Implement joint. Rail joint.
Knitting machine, F. Wilcomb 397,408
Knitting machine, circular, G. Cooper 397,417
Knitting machine, circular, W. H. Stewart 397,444
Knitting machine circular warp, Payne & Campion 397,142
Knitting machine, straight, H. B. Payne 397,141
Knitting machine, warp, Payne & Campion 397,140
Lamp manufacture, incandescent, J. A. Vandegrift 397,479
Lamps, suspension device for, W. C. Homan 397,462
Latch and lock, combined, M. E. De Aguero 397,226
Letter box indicator, G. A. Colton 397,341
Leveling instrument, C. A. Karr 397,294
Lid or cover for metallic or other receptacles, W. T. Seymour 397,391
Lifting machine, coin-controlled, B. Fuchter 397,229
Lifting machine, coin-controlled, J. G. Kearney .. 397,295
Lock. See Nut lock. Paper box lock. Seal lock.
Lock nut, Allen & Loree 397,103
Loom, A. Urbahn 397,186
Mat. See Door mat.
Mat, C. Wolcott 397,453
Match flasks, latch for, M. B. Springer 397,399
Measuring device, liquid, Winters & Bingham 397,452
Medicine, remedy for rheumatism, etc., J. F. Lindgren 397,192
Metal, producing forged articles from scraps of, E. N. Colwell 397,278
Metal sheet for surfacing walls, etc., H. A. Lee ... 397,298
Micrometer gauge, C. H. Russom 397,442
Mill. See Grinding mill.
Mould. See Glass mould.
Moulding machine, sand, A. L. Teetor 397,316
Motor, Heinsohn & Hoffmann 397,288
Music, binding sheet, E. Harris 397,360
Music leaf turner, F. H. Loughlin 397,241
Nail machine, wire, J. B. Hastings 397,426
Nails, machine for rolling, H. E. Fuller 397,460
Nails, rolling, H. E. Fuller 397,422
Nut lock, J. C. Morehead 397,436
Oil cup, C. H. Nunn 397,202
Oil for fuel, apparatus for burning kerosene, G. L. Swett 397,150
Oiler, automatic, A. Kinney 397,432
Open hearth furnace, H. W. Lash *et al.* (r) 10,984
Ore feeder, J. & J. H. Hendy (r) 10,983
Pad. See Truss pad.
Paint, D. Bell 397,105
Palette and easel, combined, Brown & Moody. ... 397,108
Paper bag, L. D. Benner 397,217
Paper box lock, F. E. De Long 397,227
Paper boxes or wrappers, graduated blank for, W. C. Tiffany 397,475
Paper, conservatory for, I. M. Chase 397,276
Paper garment, Mudge & Wasson 397,437
Paper making machine, Carter & Savery 397,275
Paper, naphthaline, A. Tsheppe 397,259
Pen, fountain, T. F. Bourne 397,413
Pen, fountain, O. F. Grant 397,123
Phonograph recorder and reproducer, T. A. Edison 397,280
Photograph burnisher, S. H. Randall 397,309
Photographic camera, J. J. Higgins 397,428, 397,429
Piano case, P. Gmehlin 397,121
Piano forte action, Kranich & Bach 397,239
Picker. See Cotton picker.
Picture frames, canvas stretcher for, W. Murphy 397,139
Pin. See Hair pin.
Pipe. See Hose pipe.
Pipe coupling insulating, S. Bergmann 397,218
Pipe joint delineator, G. S. Kimball 397,132
Pipes together, steam power apparatus for screwing, L. A. Stanford 397,400
Planer, cylinder, F. B. Philbrick 397,246
Planing machine rolls, J. R. Thomas 397,151
Planter, J. J. Ballard 397,215
Planter, corn, J. D. Fitzgerald 397,351
Plaster, etc., compound to restrain the setting of, G. R. King 397,296
Plow, M. J. Todd 397,317
Plow, mould board or breaking, M. S. & E. L. Cadwell 397,415
Pocketbook, purse, or satchel frame fastening, L. B. Prahar 397,248
Post hole machine, W. W. & G. V. Nivison 397,383
Power. See Horse power.
Power from water and air currents, means for obtaining motive, J. B. Fox 397,118
Press. See Baling press. Hay press.
Printing machines, means for collecting and evening up sheets for, W. Scott 397,314
Prints, toning blue, H. Whiting 397,480
Propelling and steering apparatus, pneumatic, R. A. Chesebrough 397,223
Protector. See Boot or shoe protector.
Pump, filter, O. H. Woodworth 397,263
Racing boat, tubular, F. Frenzel, Jr 397,282
Rail joint, I. & W. T. Lynd 397,242
Rail point, switch, T. G. Palmer 397,306
Railway, cable or electric street, W. S. Phelps 397,385
Railway signal, electric, A. Z. Boda 397,270
Railway signaling device, cable, W. M. Bulkley ... 397,335
Railway tracks, apparatus for depositing torpedoes upon, J. F. McLaughlin 397,378
Railways, danger signal for, J. Prince 397,469
Rake. See Hay rake.
Rasp cutting machine, P. S. Stokes 397,254
Reel. See Fishing reel.
Regulator. See Draught regulator.
Ring. See Curtain ring. Earring.
Road engine, H. K. Sams 397,144
Rock drills, device for sharpening, F. A. Grace 397,230
Rolling mill plant, E. L. Clark 397,339
Rolling pins, etc., revolving handle for, J. H. Sunderman 397,149
Roofing or siding, metallic, L. H. Montross 397,381
Salt box, E. S. Ayer 397,104
Sanding machine, mould, G. Potts 397,247
Sawing machine, W. E. Patterson 397,203
Scale measure, S. J. Hester 397,128
Scales, hydrostatic indicator for weighing, H. A. Lewis 397,464
Screw, jack, M. Reisch 397,387
Screws, tool for nicking heads of, J. F. Thayer 397,208
Seal lock, O. T. Welch 397,210
Seal, metallic, A. J. Phelps 397,384
Secondary battery, W. A. Shaw 397,443
Seed, machine for delinting cotton, T. P. Sullivan 397,448
Sewage by electricity, apparatus for purifying, W. Webster, Jr 397,407
Sewing machine shuttle, C. H. Benoit 397,269
Shavings, machine for making packing, Evenstad & Senstad 397,281
Sheet metal binding, W. Duncan 397,279
Shelf support, adjustable, L. Schmitt 397,251
Shingle sawing machine, E. Anderson 397,328
Shipping case, B. S. Atwood 397,214
Signal. See Railway signal.
Signal transmitter, multiple, M. Martin 397,194
Sled brake, F. Gretzler 397,231
Smoke consuming furnace, J. Gilbert 397,353
Smoke-consuming furnace, C. McGinnis 397,135
Snap hook, H. G. McLean 397,136
Spark arrester, G. B. Taylor 397,258
Spark extinguisher and arrester, Q. J. Hoke 397,363
Speed indicator, E. C. Smith 397,395
Spittoon, A. E. Moore 397,200
Spring. See Cart spring. Vehicle spring.
Spur, W. Nicholls 397,304
Stall and stock handling apparatus, combined, C. F. Shedd 397,206
Stand. See Christmas tree stand.
Steam boiler, W. E. Kelly 397,130
Steam engine, G. W. Price 397,468
Steam engine, revolving piston, W. E. Leonard ... 397,299
Steam trap, measuring, G. Guntz 397,184
Steel, manufacture of, Tilford & Redemann, 397,476 to 397,478
Stitchingmachine, wire, C. L. Lasch 397,372
Stone, apparatus for leveling and squaring, M. Hansel 397,286
Stone cutting machine, H. Young 397,410
Stone sawing machine gauge, Melchior & Meyer .. 397,244
Stools or tables, detachable leg and standard for, G. E. Clow 397,225
Stopper. See Bottle stopper.
Strainer holder, L. A. Tarring 397,227
Strap. See Hose strap.
Street sprinkling apparatus, M. Haughey 397,287
Sunshade, E. Dean 397,172
Surgical appliance, J. H. Bowen 397,106
Switch operating and locking device, T. W. Burley 397,414
Syringe, B. F. Sutton 397,256
Tap, expansible and collapsible, T. F. Hammer ... 397,126
Tap, pipe, H. C. Bradford 397,167
Tapping bush for barrels, J. McKenzie 397,377
Telegraph, printing, A. T. McCoy 397,466
Telephone call box, Griffith & Burbank 397,284
Telephone circuit and apparatus, J. A. Barrett 397,331
Telephone or analogous electric system, A. B. Ferdinand 397,176
Telephone paper pad holder, J. B. Seymour, Jr 397,422
Tennis racket, R. B. Brown 397,220
Thermometer, oven, Henderson & Johnston 397,127
Thill coupling, W. H Bowman 397,455
Thill, vehicle, E. J. Hagan 397,357
Tire apparatus, P. Schlosser 397,390
Tire, vehicle wheel, H. M. Du Bois 397,458, 397,459
Toy figure, cut, J. McLoughlin 397,302
Toy, flying, F. J. Lutz 397,435
Trap. See Steam trap.
Tricycle, W. L. Fay 397,348
Trowel, plastering, A. Hill 397,129
Truss pad, O. Eckert 397,345
Type forms, matrix impression guard for, R. B. Hastie 397,232
Valve, G. A. Matteson 397,134
Valve, electric stop, R. Wellens 397,260
Valve for fluid pressure brakes, H. Guels 397,125
Valve for oil well stand pipes, discharge, R. M. Dunn 397,115
Valve gear, R. Wilby 397,323
Valve, slide, F. C. Cleaver 397,170
Vehicle dash board, C. L. Baker 397,329
Vehicle spring, E. Jarrell 397,366
Velocipede pedal, T. B. Jeffery 397,188
Vending apparatus, F. M. Leavitt 397,297
Vending apparatus, J. W. Vaughn 397,319
Veneer machine, rotary cutting, E. S. & C. R. Gorham 397,181
Ventilator, E. A. Goodell 397,122
Violin rest, J. Bohmann 397,454
Vise, W. H. Remsen 397,470
Wash board, A. R. Kibbe 397,430
Washing machine, I. F. Field 397,349
Washing machine, E. E. Willis 397,211
Watchmaker's tool, Leach & Figarotta 397,191
Watch, stem winding and setting, H. Schutz 397,318
Watches, etc., demagnetizing, J. Greaves 397,423
Water closets, siphon valve for, C. H. Harkins ... 397,359
Wheel. See Wheelbarrow wheel.
Wheels, forming vehicle, T. B. Jeffery 397,189
Wheelbarrow wheel, F. F. Farnsworth 397,347
Whiffletree hook, J. R. Davis 397,112
Whiffletree hook, S. O. Nichols 397,201
Whip, H. A. Cowles 397,456
Windows, support for persons cleaning, W. Prout 397,249
Wire, apparatus for drawing, A. S. & T. Bolton 397,272
Wire, drawing, A. S. & T. Bolton 397,271
Wire rope or cable, W. H. & T. Laidler 397,371
Woodworker, W. H. Doane 397,113

DESIGNS.

Carpet, E. Fisher ..... 18,897 to 18,901
Carpet, W. L. Jacobs 18,904, 18,905
Carpet, C. W. Swapp ..... 18,910 to 18,916
Fireplace lining, E. L. Caley 18,896
Glass, surface ornamentation of, Brogan & Malloch ..... 18,892 to 18,894
Grate, portable fireplace, E. L. Caley 18,895
Hat, lady's, L. S. Stewart 18,908
Medal or badge, W. Friederich 18,902
Monument, century, H. C. Borgner 18,891
Necktie, A. Hellenberg 18,903
Register, floor, W. W. Sweetland 18,909
Rug, W. T. Smith 18,906, 18,907

TRADE MARKS.

Canned oysters, fruits, and vegetables, Miller Bros. & Co 16,241
Chemical alkalies, W. Gossage & Sons 16,245
Clothing for men, boys, and children, ready-made, J. & L. Wineman 16,244
Guitars, mandolins, zithers, and banjos, Lyon & Healy 16,247
Liniment and like compounds, D. J. Enright 16,237
Meal, corn flour, cornmeal, hominy, grits, and feed, degerminated, Miller, Case & Clausen 16,248
Medicinal plasters, Potter Drug and Chemical Co.. 16,242
Medicine for the cure of heaves in horses, G. T. Hollyday 16,238
Medicines for diseases of the blood and for female diseases, J. W. Jones 16,239
Medicines for external use, Soler & Guardias 16,243
Mince meat for pies, condensed, Merrell & Soule .. 16,240
Oysters, A. Booth Packing Company 16,236
Pens, metallic, Turner & Harrison 16,250
Razors, pocket knives, scissors, shears, and like articles of cutlery, A. J. Jordan 16,246
Soap, laundry, Procter & Gamble 16,249

A Printed copy of the specification and drawing of any patent in the foregoing list will be furnished from this office for 25 cents. In ordering please state the name and number of the patent desired, and remit to Munn & Co., 361 Broadway, New York.

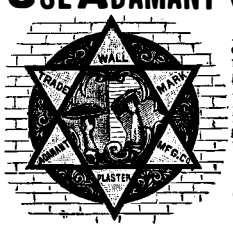
Canadian Patents may now be obtained by the inventors for any of the inventions named in the foregoing list, provided they are simple, at a cost of $40 each. If complicated, the cost will be a little more. For full instructions address Munn & Co., 361 Broadway, New York. Other foreign patents may also be obtained.

Advertisements.

Inside Page, each insertion - - - 75 cents a line.
Back Page, each insertion - - - $1.00 a line.

The above are charges per agate line—about eight words per line. This notice shows the width of the line, and is set in agate type. Engravings may head advertisements at the same rate per agate line, by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

USE ADAMANT WALL PLASTER



It is **Hard, Dense, and Adhesive.** Does not *check or crack.* It is impervious to wind, water, and disease germs. It dries in a few hours. It can be applied in any kind of weather. It is in general use. Licenses granted for the mixing, using, and selling. Address

ADAMANT MFG. CO.
71 E. Genesee Street, Syracuse, N. Y.

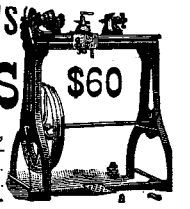
TO MANUFACTURERS!

Wood Working Machinery Plant FOR SALE.

Situated in a live manufacturing city in New England, now doing a very profitable business—sales about $36,000 a year. The Tools, Patterns, Good Will, Stock, and Machines on hand will be sold. No machines have a better reputation than those manufactured by this company. A full line of wood working machinery has been and can be made in the shops. Two lines of railroad ensure cheap freight rates. The reason for selling is too much other business that cannot be relinquished. Full particulars on application.

B. G. UNDERWOOD,
31 PEMBERTON SQUARE, Boston, Mass.

SEBASTIAN, MAY & CO'S
Improved Screw Cutting
Foot & Power **LATHES**



Drill Presses, Chucks, Drills, Dogs, and machinists' and amateurs' outfits. *Lathes on trial.* Catalogues mailed on application.
165 W. 2d St., Cincinnati, O.

ICE-HOUSE AND COLD ROOM.—BY R. G. Hatfield. With directions for construction. Four engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, **59.** Price 10 cents. To be had at this office and of all newsdealers.

ARTESIAN
Wells, Oil and Gas Wells, drilled by contract to any depth, from 50 to 3000 feet. We also manufacture and furnish everything required to drill and complete same. Portable Horse Power and Mounted Steam Drilling Machines for 100 to 600 ft. Send 6 cents for illustrated catalogue. **Pierce Artesian and Oil Well Supply Co.,** 80 Beaver Street, New York.

THE PHONOGRAPH.--A DETAILED description of the new and improved form of the phonograph just brought out by Edison. With 8 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **632.** Price 10 cents. To be had at this office and from all newsdealers.

INGERSOLL ROCK DRILL CO.,
10 PARK PLACE, NEW YORK.
Improved "Eclipse"
ROCK DRILLS,
For Mining, Tunneling, Shaft-Sinking, Quarrying, Submarine drilling, and for all kinds of rock excavation.
"Straight Line" AIR COMPRESSORS, Boilers, Steam and Horse Power Hoists, Electric Blasting Batteries and General Mining Machinery
Send for full descriptive Catalogue

ICE-HOUSE AND REFRIGERATOR. Directions and Dimensions for construction, with one illustration of cold house for preserving fruit from season to season. The air is kept dry and pure throughout the year at a temperature of from 34° to 36°. Contained in SCIENTIFIC AMERICAN SUPPLEMENT No. **116.** Price 10 cents. To be had at this office and of all newsdealers.

ROCK DRILLS

AIR COMPRESSORS &
GENERAL MACHINERY FOR
MINING, TUNNELING,
QUARRY & RAILROAD WORK.
RAND DRILL Co 23 PARK PLACE NEW YORK

WOOL HAT MAKING.—FULL DESCRIPTION of the process.—Wool washing, carding and forming, settling, bumping and washing out, stretching or stumping, drying, storing and steaming, pulling out, dyeing, blocking, storing, pressing, finishing, rounding, curling and ironing, paring, trimming and shaping, velouring off. With 20 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, NOS. **626, 628,** and **629.** Price 10 cents each. To be had at this office and from all newsdealers.

$3 PRINTING PRESS
For cards, labels, etc. Circular press, $8. Size for small newspapers, $44. Rotary jobber, 9x13, $100. Do all your own printing and advertising. Full printed rules for type-setting, etc. Send 2 stamps for catalogue of presses, type, cards, etc., to factory. **KELSEY & CO., Meriden, Conn.**

AIR, PURIFICATION OF.—BY D. Prince, M.D. An experimental study in relation to the removal from the air of the dust or particulate material, supposed to produce yellow fever, small-pox, and other infectious disease. 1 illustration. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **569.** Price 10 cents. To be had at this office and from all newsdealers.

"Star" Foot Lathe Swings 9x25 in.
Screw Cutting Automatic Cross Feed, etc.
LATHE
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mf'g Co., 695 Water St., Seneca Falls, N. Y.

© 1889 SCIENTIFIC AMERICAN, INC

Manufacture of Soap and Candles

A New and Thoroughly Modern Book. The Most Complete and Valuable in any Language.

A Practical Treatise on the Manufacture of Soap and Candles, based upon the Most Recent Experiences in the Science and the Practice; comprising the Chemistry, the Raw Materials, the Machinery and Utensils, and Various Processes of Manufacture, including a great Variety of Formulas. Edited chiefly from the German of Dr. C. Deite, A. Englehardt, Dr. C. Schaedler, and others. With Additions and Lists of American Patents relating to these subjects. By William T. Brannt, one of the Editors of "The Techno-Chemical Receipt Book." Illustrated by 168 engravings. 8vo, 677 pages.....**$7.50**

☞ *An illustrated circular showing the contents and specimens of the engravings of this valuable book, 8 pages, quarto, will be sent free to any one in any part of the world who will furnish us with his address*

RECENTLY PUBLISHED.

BRANNT.—A Practical Treatise on Animal and Vegetable Fats and Oils, comprising both Fixed and Volatile Oils, etc., as well as the Manufacture of Artificial Butter, Lubricants, including Mineral Lubricating Oils, etc., and on Ozokerite, etc. By Wm. T. Brannt. 244 engravings. 730 pages, 8vo.....**$7.50**

☞ *An illustrated circular, 8 pages, quarto, showing the full table of contents of this book, sent free of postage to any one addressing us.*

CREW.—A Practical Treatise on Petroleum. By Benjamin J. Crew. With an appendix on the Oil Regions and the Geology of Natural Gas. By Chas. A. Ashburner, Geologist in charge Pennsylvania Survey. Illustrated by 70 engravings and 2 plates. 508 pages, 8vo.....**$5.00**

☞ *An illustrated circular of this book, 4 pages, 4to, sent free.*

☞ *The above or any of our Books sent by mail, free of postage, at the publication prices, to any address in the world.*

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS & IMPORTERS
810 Walnut St., Philadelphia, Pa., U. S. A.

ARCHITECTURAL BOOKS.

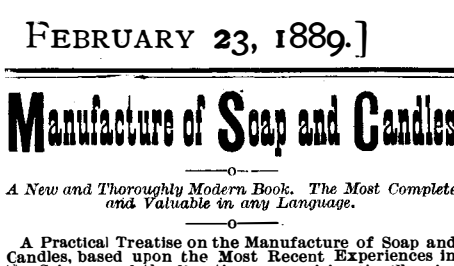
Useful, Beautiful, and Cheap.

To any person about to erect a dwelling house or stable, either in the country or city, or any builder wishing to examine the latest and best plans for a church, school house, club house, or any other public building of high or low cost, should procure a complete set of the ARCHITECTS' AND BUILDERS' EDITION of the SCIENTIFIC AMERICAN.

The information these volumes contain renders the work almost indispensable to the architect and builder, and to persons about to build for themselves they will find the work suggestive and most useful. They contain colored plates of the elevation, plan, and detail drawings of almost every class of building, with specification and approximate cost.

Four bound volumes are now ready and may be obtained, by mail, direct from the publishers or from any newsdealer. Price, $2.00 a volume. Stitched in paper covers. Subscription price, per annum, $2.50. Address and remit to

MUNN & CO., Publishers,
361 Broadway, New York.



PETROLEUM BOAT. DESCRIPTION of a petroleum motor devised by Mr. Lenoir for the propulsion of small boats. With 2 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **637.** Price 10 cents. To be had at this office and from all newsdealers.

A NEW CATALOGUE OF VALUABLE PAPERS

Contained in SCIENTIFIC AMERICAN SUPPLEMENT, sent *free of charge* to any address.
MUNN & CO., 361 Broadway, New York.

GLACIAL EPOCHS AND THEIR PERIODICITY.—By Adolphe d'Assier. A presentation of the considerations that tend to establish the fact that the progressive cooling of the earth must, in the course of ages, have produced circumpolar glaciers, and that the periodic and alternate return of these in the two hemispheres is closely connected with the secular displacement of the perihelion. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, NOS. **631** and **632.** Price 10 cents each. To be had at this office and from all newsdealers.

POLAR PLANIMETER.—A PAPER by E. A. Giessler, C.E., giving the theory and use of this useful instrument. With 5 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **637.** Price 10 cents. To be had at this office and from all newsdealers.

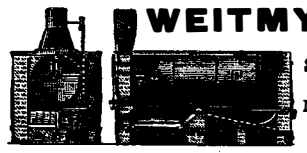
PERFECT NEWSPAPER FILE

The Koch Patent File, for preserving newspapers, Magazines, and pamphlets, has been recently improved and price reduced. Subscribers to the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT can be supplied for the low price of $1.50 by mail, or $1.25 at the office of this paper. Heavy board sides; inscription "SCIENTIFIC AMERICAN" in gilt. Necessary for every one who wishes to preserve the paper. Address

MUNN & CO., Publishers SCIENTIFIC AMERICAN.

DEAFNESS and Noises in HEAD

Entirely Cured by Peck's Pat. Improved Tubular Ear Cushions. Whispers heard distinctly. Unseen, comfortable, self-adjusting. *Successful when all remedies fail.* Sold only by **F. HISCOX, 853** Broadway, cor. 14th St., N.Y. Write or call for illustrated book of proofs FREE.



WEITMYER PATENT FURNACE.

Boilers of Every Description.
IDE Automatic Engines, Traction and Portable Engines,
STEAM ROAD ROLLERS,
Manufactured by FOUNDRY & MACHINE DEPT., Harrisburg, Pa., U. S. A.
New York Office, Messrs. Fleming & Kimball, 17 Dey Street. New England Office, Messrs. John Post, Jr. & Co., 70 Kilby Street, Boston. Baltimore Office, Messrs. Thomas K. Carey & Bro., 26 Light Street.

HOW TO MAKE AN INCUBATOR.—Full directions, illustrated with 7 figures. Also directions for operating the apparatus. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **612.** Price 10 cents. To be had at this office and from all newsdealers.

MADE WITH BOILING WATER.

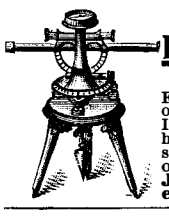
EPPS'S

GRATEFUL—COMFORTING

COCOA

MADE WITH BOILING MILK.

PHTHISIS.—A PAPER BY DR. H. C. Wood, describing in detail the new treatment of consumption by sulphureted hydrogen. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **594.** Price 10 cents. To be had at this office and from all newsdealers.



HARMON'S IMPROVED
Leveling Instrument.
With or without Compass.
For Engineers, Contractors, and all others requiring a low price Leveling Instrument for grading, measuring heights, squaring, or getting any desired angle. Illustrated circular sent on receipt of stamp.
JOHN W. HARMON, 65 Haverhill Street, Boston, Mass.

RAILWAY, SINGLE-LINE.—DESCRIPTION of the Lartigue system of single-track railway as applied between Listowel and Ballybunion, Kerry. With 5 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **640.** Price 10 cents. To be had at this office and from all newsdealers.

LIME KILN THAT SAVES 36 PER CENT. over any **other Kiln known.** Guaranteed to burn No. 1 lime with coal or wood. Rights for sale.
C. D. PAGE, Patentee, Rochester, N. Y.

MANGANESE STEEL AND ITS PROPERTIES.—Abstract of two papers on this subject by Mr. Robert A. Hadfield, Assoc. M. Inst. C.E. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **640.** Price 10 cents. To be had at this office and from all newsdealers.

CHICAGO HOROLOGICAL INSTITUTE
175 Dearborn Street, Chicago, Ill.
Established for giving **Practical and Technical Instruction in Watchmaking.** Students can enter this School at any time. Send for circular giving terms and full information.

NATURAL GAS INDUSTRY AT PITTSBURG, Pa.—A brief history of the Chartiers Valley Gas Company. With 5 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **627.** Price 10cents. To be had at this office and from all newsdealers.

ANÆSTHETICS, A LESSON FOR those who use.—By J. J. Chisholm, M.D. Remarkable cases of resuscitation of patients apparently dead from the inhalation of chloroform, with methods used. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **642.** Price 10 cents. To be had at this office and from all newsdealers.

MOSS ENGRAVING Co 535 PEARL ST NEW YORK
cor Elm St
OUR SPECIALTY: FINE ILLUSTRATED CATALOGUES
BY OUR NEW MOSS TYPE PROCESS.
Send Green Stamp for Moss Type Specimens.

BRIDGE CONSTRUCTION, DEVELOPMENT OF.—A paper by Prof. W. P. Trowbridge, giving a history of the art of building bridges, along with notices of some remarkable historic bridges. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **637.** Price 10 cents. To be had at this office and from all newsdealers.

2nd MACHINERY

Lists Sent.
N. Y. Mach'y Depot, Bridge Store 16, Frankfort St., N.Y.

ELECTRIC CONVEYORS.—DESCRIPTION of two ingenious systems for the electric carriage of small packages. Illustrated with 13 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **464.** Price 10 cents. To be had at this office and from all newsdealers.

CARPENTERS' TOOLS
Reduced prices. Send stamps for Catalog. 1000 Illustrations.
JNO. WILKINSON CO., 55 State St., Chicago.

ROYAL MICROSCOPIC SOCIETY.—Annual address by the President, Dr. Dollinger, F.R.S., delivered Feb. 8, 1888. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **643.** Price 10 cents. To be had at this office and from all newsdealers.

LINSEED OIL.—AN ELABORATE paper by Jas. C. Duff, on the manufacture, uses, and properties of this product. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **634.** Price 10 cents. To be had at this office and from all newsdealers.

DELAFIELD'S PATENT SAW CLAMP.—1889 PATTERN.

Stronger than the old style. Clamp without blade, 50 cents. Metal cutting blades ½ inch wide, 7 cents each, 70 cents per dozen; 1 inch wide, 40 cents each. All postpaid. Discount to dealers. Write for circular.
NOROTON MANUFACTURING WORKS, NOROTON, CONN.

PULLEYS, HANGERS, FRICTION CLUTCHES. PROGRESS MACHINE WORKS, A. & F. BROWN, **44 Park Place, N. Y.**

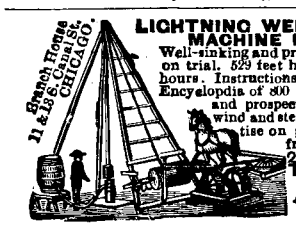
The TRENTON ENGINE

AUTOMATIC CUT-OFF BALANCE VALVE
Highest duty, economy, and durability guaranteed.
Phenix Iron Co. Trenton, N.J., M'frs.
F. VAN WINKLE, Agt., 91 Liberty St., N. Y.

THE NEW CROTON AQUEDUCT.—Detailed description of the great aqueduct now being constructed to increase the water supply of New York City, and also of the great dam which it is proposed to build across the Croton River, at Quaker Bridge. With engravings and a map. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **558.** Price 10 cents. To be had at this office and from all newsdealers.

MODELS

EXPERIMENTAL WORK AND LIGHT MACHINERY.
N. ERLANDSEN, 107 Rivington Street, New York.



LIGHTNING WELL-SINKING MACHINE MAKERS.
Well-sinking and prospecting tools sent on trial. 629 feet has been sunk in 8 hours. Instructions for beginners. An Encyclopedia of 800 Engravings of well and prospectors' tools, pumps, wind and steam engines. A treatise on gas and oil. Book free, mailing charges 25 cts. each.
The American Well Works,
AURORA, ILL., U. S. A.

LOCKS OF THE PANAMA CANAL.—Description of the lock gates devised by Mr. Eiffel for use on the proposed Panama lock canal. With 12 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **639.** Price 10 cents. To be had at this office and from all newsdealers.

OIL WELL SUPPLY CO. Ltd.

91 & 92 WATER STREET,
Pittsburgh, Pa.,
Manufacturers of everything needed for
ARTESIAN WELLS
for either Gas, Oil, Water, or Mineral Tests, Boilers, Engines, Pipe, Cordage, Drilling Tools, etc. Illustrated catalogue, price lists and discount sheets on request.

DRY AIR REFRIGERATING MACHINE. Description of Hall's improved horizontal dry air refrigerator, designed to deliver about 10,000 cubic feet of cold air per hour, when running at a speed of 100 revolutions per minute, and capable of reducing the temperature of 90° above to 50° below zero. With five figures, showing plan and side elevation of the apparatus, and diagrams illustrative of its performance. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **288.** Price 10 cents. To be had at this office and from all newsdealers.

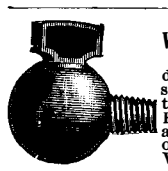
$10.00 to $50.00 per night. A light and profitable business. **Magic Lanterns and Views** of popular subjects. Catalogues on application. Part 1 Optical. 2 Mathematical, 3 Meteorological, 4 Magic Lanterns, etc.
L. MANASSE, 88 Madison Street, Chicago, Ill.

BONANZA TO AGENTS SAMPLES FREE
Write immediately. to **GEO. A. SCOTT,** New York City

ELECTROTECHNICS, DEFINITIONS and Designations in.—A list of the symbols proposed by Mr. Jamieson for electrical units, magnetism, and electric measurements. With 4 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **595.** Price 10 cents. To be had at this office and from all newsdealers.

MODEL and EXPERIMENTAL WORK —A SPECIALTY.
Send for Circulars.
C. E. Jones & Bro.
CINCINNATI, O.
(Mention this Paper.)

ROPE TRANSMISSION OF POWER.—Some valuable suggestions to those who would apply rope in place of leather belting for the transmission of power over long distances. With 12 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **638.** Price 10 cents. To be had at this office and from all newsdealers.



A PRACTICAL SUCCESS.
VAN DUZEN'S PAT. LOOSE PULLEY OILER.
Thousands in satisfactory everyday use. Entire reliability and constancy demonstrated in a two years' test by (would be) Eastern skeptics. Economy shown by reasonable prices and perfect performance. Send for our "Catalogue No. 55."
VAN DUZEN & TIFT, Cincinnati, O

BARREL MACHINERY.

E. & B. HOLMES,
BUFFALO, N. Y.

ROUND AUGER BIT

BORING SQUARE HOLES.
The Forstner Bit is far superior to the "Old Centre Guided Bits." **Smooth, Round, Oval,** or **Square Holes.** For fine carpenter and pattern work. Highest awards American Institute, N. Y., 1887-8. Send $8.25 for set (3-8 to 11-8) in fine case, or 75c. for ¾ in. sample, mailed free. For sale everywhere. Thousands are being sold. Bridgeport Gun Implement Co., 17 Maiden Lane, N. Y.

PULLEYS. Cheapest, Lightest, and Best. Made by Hardwood Split P. Co., Menasha, Wis.

Manufacturers who desire first-class locations in the region near Pittsburg, on line of P. R.R., on most favorable terms, will please address **NATURAL GAS**
R. S. JAMISON, Greensburg, Pa.

AGENTS WANTED ON SALARY. **$75 per month and expenses** paid any active man or woman to sell our goods by sample and live at home. Salary paid promptly and expenses in advance. Full particulars and sample case FREE. We mean just what we say. Address **Standard Silverware Co., Boston, Mass.**

25% TO 50% SAVING **THE MACKEY AUTOMATIC SPRINKLER**
Thermostatic Fire Alarm operated by Electricity.
Positive in its action. Easily tested. No attendance required. Endorsed by Underwriters. **The J. C. Mackey Co.,** 76-80 So. Water St., Syracuse, N. Y., U. S. A.

Construction of Breakwater at Glen Cove Harbor, N.Y.—Engineer Office, U. S. Army, Room 57, Army Building, corner Houston and Greene Streets, New York, February 11, 1889.—Sealed proposals in triplicate for Construction of a Breakwater at Glen Cove Harbor, N. Y., will be received at this office until twelve (12) o'clock noon, on Wednesday, March 13, 1889. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office.
D. C. HOUSTON, *Lieut.-Colonel of Engineers.*

Hire of Dredging Plant for Improving Housatonic River, Conn.—Engineer Office, U. S. Army, Room 57, Army Building, corner Houston and Greene Streets, New York, February 11, 1889.—Sealed proposals in triplicate for Hire of Dredging Plant for Improving Housatonic River, Conn., will be received at this office until twelve (12) o'clock noon, on Wednesday, March 13, 1889. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office.
D. C. HOUSTON, *Lieut.-Colonel of Engineers.*

FOREIGN PATENTS

THEIR COST REDUCED.

The expenses attending the procuring of patents in most foreign countries having been considerably reduced the obstacle of cost is no longer in the way of a large proportion of our inventors patenting their inventions abroad.

CANADA.—The cost of a patent in Canada is even less than the cost of a United States patent, and the former includes the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, British Columbia, and Manitoba.

The number of our patentees who avail themselves of the cheap and easy method now offered for obtaining patents in Canada is very large, and is steadily increasing.

ENGLAND.—The new English law, which went into force on Jan. 1st, 1885, enables parties to secure patents in Great Britain on very moderate terms. A British patent includes England, Scotland, Wales, Ireland and the Channel Islands. Great Britain is the acknowledged financial and commercial center of the world, and her goods are sent to every quarter of the globe. A good invention is likely to realize as much for the patentee in England as his United States patent produces for him at home, and the small cost now renders it possible for almost every patentee in this country to secure a patent in Great Britain, where his rights are as well projected as in the United States.

OTHER COUNTRIES.—Patents are also obtained on very reasonable terms in France, Belgium, Germany, Austria, Russia, Italy, Spain (the latter includes Cuba and all the other Spanish Colonies), Brazil, British India, Australia, and the other British Colonies.

An experience of FORTY years has enabled the publishers of THE SCIENTIFIC AMERICAN to establish competent and trustworthy agencies in all the principal foreign countries, and it has always been their aim to have the business of their clients promptly and properly done and their interests faithfully guarded.

A pamphlet containing a synopsis of the patent laws of all countries, including the cost for each, and other information useful to persons contemplating the procuring of patents abroad, may be had on application to this office.

MUNN & CO., Editors and Proprietors of THE SCIENTIFIC AMERICAN, cordially invite all persons desiring any information relative to patents, or the registry of trade-marks, in this country or abroad, to call at their offices, 361 Broadway. Examination of inventions, consultation, and advice free. Inquiries by mail promptly answered.

Address, **MUNN & CO.,**
Publishers and Patent Solicitors,
361 Broadway, New York.

BRANCH OFFICES: No. 622 and 624 F Street, Pacific Building, near 7th Street, Washington, D. C.

Clark's Noiseless Rubber Truck Wheels
Save floors. Anti-Friction Casters. Rubber Furniture Casters, etc.
Catalogue free.
Geo. P. Clark, Box L, **Windsor Locks, Ct.**

A SPECIALTY WANTED.

I want an article to manufacture, or the agency of something that I can control, advertise, and build up. No patent medicine or catchpenny affair wanted. Ample capital and experience. Address, giving fullest particulars, **H. 3,** care of Lord & Thomas, Chicago, Ill.

WANTED—A competent Engineer to run Boyle Ice machinery. Address with reference, experience, and salary required. NATCHEZ ICE CO., Natchez, Miss.

RECEIVER'S SALE

The entire contents of the Foundry of the late firm of S. S. Hepworth & Co., at Yonkers, (Glenwood Station), New York, consisting of lathes, planers, boring mills, drill presses, milling machines, several cranes, one 15 ton travelling crane, several tons of scrap iron, two safes, office furniture, patterns, drawings, a large quantity of valuable machinery, and other personal property will be sold on February 28, 1889, at ten o'clock A. M., at the above mentioned foundry. Premises now open for inspection. Send for catalogue to
Henry T. Dykman, Receiver, White Plains, N. Y.

The Scientific American

PUBLICATIONS FOR 1889.

The prices of the different publications in the United States, Canada, and Mexico are as follows:

RATES BY MAIL.

The Scientific American (weekly), one year	$3.00
The Scientific American Supplement (weekly), one year	5.00
The Scientific American, Export Edition (monthly) one year	5.00
The Scientific American, Architects and Builders Edition (monthly), one year	2.50

COMBINED RATES.

The Scientific American and Supplement	$7.00
The Scientific American and Architects and Builders Edition	5.00
The Scientific American, Supplement, and Architects and Builders Edition	9.00

Proportionate Rates for Six Months.

This includes postage, which we pay. Remit by postal or express money order, or draft to order of
MUNN & CO., 361 Broadway, New York.

JOHN MILLARD writes from Odiebarg, Ind., Nov. 20.—Dyke's Beard Elixir has produced a heavy mustache on my upper lip in 4 weeks. My face was entirely smooth. Hundreds more.

DYKE'S Beard Elixir grows the heaviest beard and hair in 4 weeks. One Pkg. do the work of 3. Guaranteed now, four times the growing strength of any remedy known. Price 25c. each. 4 for 50c. stamps, sealed. SMITH'S MFG. CO., Palatine, Ills.

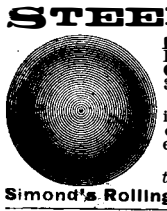
© 1889 SCIENTIFIC AMERICAN, INC

Advertisements.

Inside Page, each insertion - - - 75 cents a line.
Back Page, each insertion - - - $1.00 a line.

The above are charges per agate line—about eight words per line. This notice shows the width of the line, and is set in agate type. Engravings may head advertisements at the same rate per agate line, by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

STEEL BALLS.



For Anti-Friction Bearings, of Best Cast Steel, Hardened, Ground, and Burnished, from 3-16 in. to 2 in. diameter.

In quality and density of metal, in uniformity of temper, and in accuracy and nicety of finish warranted unequaled.

☞ *Samples and prices on application.*

Simond's Rolling-Machine Co., Fitchburg, Mass.

TO BUSINESS MEN.

The value of the SCIENTIFIC AMERICAN as an advertising medium cannot be overestimated. Its circulation is many times greater than that of any similar journal now published. It goes into all the States and Territories, and is read in all the principal libraries and reading rooms of the world. A business man wants something more than to see his advertisement in a printed newspaper. He wants circulation. This he has when he advertises in the SCIENTIFIC AMERICAN. And do not let the advertising agent influence you to substitute some other paper for the SCIENTIFIC AMERICAN, when selecting a list of publications in which you decide it is for your interest to advertise. This is frequently done, for the reason that the agent gets a larger commission from the papers having a small circulation than is allowed on the SCIENTIFIC AMERICAN.

For rates see top of first column of this page, or address

MUNN & CO., Publishers,
361 Broadway, New York.

THE KODAK CAMERA

Makes 100 Instantaneous Pictures by simply pressing a button. Anybody can use it who can wind a watch. No focusing. No tripod. Rapid Rectilinear Lens. Photographs moving objects. Can be used indoors.

Division of Labor—Operator can finish his own pictures, or send them to the factory to be finished.

Morocco covered Camera, in handsome sole-leather case, loaded for 100 pictures, For full description of "Kodak" see SCI. AM., Sept. 15, '88.

Price, $25.00. Reloading, $2.00.

The Eastman Dry Plate & Film Co.
Rochester, N. Y. 115 Oxford St., London.
Send for copy of Kodak Primer with Kodak Photograph.

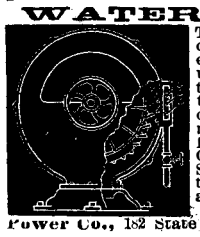
ICE-BOATS — THEIR CONSTRUCTION and management. With working drawings, details, and directions in full. Four engravings, showing mode of construction. Views of the two fastest ice-sailing boats used on the Hudson river in winter. By H. A. Horsfall, M.E. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, 1. The same number also contains the rules and regulations for the formation of ice-boat clubs, the sailing and management of ice-boats. Price 10 cents.

GUILD & GARRISON

BROOKLYN, N. Y., U. S. A.

Builders of **Steam Pumps** for Liquids or Semi-liquids. High Grade **Vacuum Pumps, Filter Press Pumps, Air Compressors, Acid Blowers, Feed Pumps, Agitators, Condensers** for **Pans, Engines, Steam Pumps, Vacuum Apparatus,** etc.

WATER MOTORS.



The most efficient and economical means of obtaining from one-eighth to fifteen horse power and upward. A motor which does the greatest amount of work with the use of the smallest stream of water, specially adapted for running cheaply and efficiently, Printing Presses, Elevators, Church Organs, Coffee Mills, Sewing Machines, Lathes, Dental Contrivances, and in fact, any piece of Mechanism.

Binghamton Hydraulic Power Co., 182 State Street, **Binghamton, N. Y.**

THE AMERICAN BELL TELEPHONE CO.

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30th, 1877, No. 186,787.

The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones not furnished by it or its licensees responsible for such unlawful use, and all the consequences thereof, and liable to suit therefor.

MALLEABLE AND FINE GRAY IRON ALSO STEEL CASTINGS FROM SPECIAL PATTERNS AND FINE TINNING JAPANNING AND FINISHING. THOMAS DEVLIN & CO. LEHIGH AVE. & AMERICAN ST. PHILA.

PATENTS.

MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had *forty-one years experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York.

BRANCH OFFICES.—No. 622 and 624 F Street, Pacific Building, near 7th Street, Washington, D. C.

JENKINS STANDARD PACKING TRADE MARK

THE ORIGINAL UNVULCANIZED PACKING CALLED THE STANDARD—As it is the Packing by which all others are compared.

Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. { **71 John Street, N. Y.** / **105 Milk Street, Boston.** / **21 North 5th St., Phila.** / **54 Dearborn St., Chicago.**

THE COPYING PAD.—HOW TO MAKE and how to use; with an engraving. Practical directions how to prepare the gelatine pad, and also the aniline ink by which the copies are made; how to apply the written letter to the pad; how to take off copies of the letter. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, NO. **438.** Price 10 cents. For sale at this office and by all newsdealers in all parts of the country.

Scientific Book Catalogue

RECENTLY PUBLISHED.

Our new catalogue containing over 100 pages, including works on more than fifty different subjects. Will be mailed free to any address on application.

MUNN & CO., Publishers Scientific American,
361 Broadway, New York.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO. HARTFORD. CONN.

THE GENERATION OF STEAM.—A lecture by Geo. H. Babcock delivered in the Sibley College Course. I. The production of Heat. Furnaces for burning bituminous and anthracite coal, wood, sawdust, waste gas, natural gas, etc., described. II. The Generation of Steam. General principles to be observed in the construction of boilers. With 14 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. **624** and **625.** Price 10 cents. To be had at this office and from all newsdealers.

FOR SALE.—STATE RIGHTS. For the Best Water Closet in the World. SANITARY PLUMBING MFG. CO., 910 Webster Street, Oakland, California.

PNEUMATIC DYNAMITE TORPEDO Gun.—An exhaustive account of this new weapon and of the experiments made with it; along with a description and illustration of a proposed dynamite cruiser. with 6 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **593.** Price 10 cents. To be had at this office and from all newsdealers.

Barnes' Foot-Power Machinery

Complete outfits for Actual Worksnop Business. A customer says: "Considering its capacity and the accuracy of your No. 4 Lathe, I do not see how it can be produced at such low cost. The velocipede foot-power is simply elegant. I can turn steadily for a whole day, and at night feel as little tired as if I had been walking around." Descriptive Price List Free.

W. F. & JOHN BARNES CO., 1999 RUBY ST., Rockford, Ill.

THE MODERN ICE YACHT. — BY Geo. W. Polk. A new and valuable paper, containing full practical directions and specifications for the construction of the fastest and best kinds of Ice Yachts of the latest, most approved forms. Illustrated with engravings drawn to scale, showing the form, position, and arrangement of all the parts. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **624.** Price 10 cents. To be had at this office and of all newsdealers.

SAWS Wanted 50,000 Sawyers and Lumbermen to send us their full address for a copy of Emerson's ☞ Book of **SAWS.** We are first to introduce NATURAL GAS for heating and tempering **Saws** with wonderful effect upon improving their quality and toughness, enabling us to reduce prices. Address **EMERSON, SMITH & CO. (Ltd.), Beaver Falls, Pa.** **SAWS**

VELOCITY OF ICE BOATS. A COLLECtion of interesting letters to the editor of the SCIENTIFIC AMERICAN on the question of the speed of ice boats, demonstrating how and why it is that these craft sail faster than the wind which propels them. Illustrated with 10 explanatory diagrams. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **214.** Price 10 cents. To be had at this office and from all newsdealers.

SEAMLESS BRASS & COPPER TUBES, SHEET BRASS BRASS WIRE. SEAMLESS DRAWN BRASS & COPPER TUBES. FINE TOOLS TAPS DIES. SEND FOR CATALOGUE 175-177 LAKE ST. CHICAGO

INVENTORS and others desiring new articles manufactured and introduced, address P. O. Box 86, Cleveland, O.

H. W. JOHNS'
Asbestos Sectional Pipe Covering

A Non-Conducting Covering for Steam and Hot Water Pipes, Boilers, etc.

READILY ATTACHED OR REMOVED BY ANY ONE.

H. W. Johns Manufacturing Company,

SOLE MANUFACTURERS OF

H. W. Johns' Asbestos Roofing, Building Felts, Fire-Proof Paints, Liquid Paints, etc.

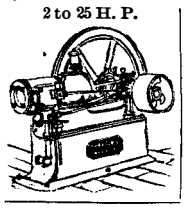
87 Maiden Lane, New York. CHICAGO. PHILADELPHIA. LONDON.

MACHINISTS' SUPPLIES SEND 13 CENTS FOR ILLUSTRATED CATALOGUE MONTGOMERY & CO 105 FULTON ST. N.Y. LATHES CHUCKS DRILLS TOOLS SCREWS CALIPERS ETC

PETROLEUM FUEL.—AN ACCOUNT of the Pennsylvania Railroad's experiments with the Urquhart system of burning petroleum on locomotives, and also of the experience of the Grazi-Haritzin Railroad with coal oil as a fuel. Contained in SCIENTIFIC AMERICAN SUPPLEMENT No. **615.** Price ten cents. To be had at this office and from all newsdealers.

CHARTER'S GAS ENGINE.

2 to 25 H. P.



The Simplest, most Reliable, and Economical Gas Engine in existence.

An impulse at every revolution. Perfect steadiness guaranteed for Arc or Incandescent Electric Lights.

Independent of gas works when desired, and **makes its own gas** at a cost of **65 cents per M feet,** or about **one cent per hour to each indicated H. P.**

A Perfectly Safe Motor for All Places and Purposes.

New York Agent, JOHN J. BOCKIE, 47 Dey Street.
Chicago Office and Salesroom, 152 Lake Street.
For circulars and prices, address

Charter Gas Engine Co.
P. O. Box 148. STERLING, ILL.

MOULDERS' TOOLS.—A DESCRIPtion of the tools used by foundry moulders and their uses. With illustrations of the different implements. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **636.** Price 10 cents. To be had at this office and from all newsdealers.

THE PENNA. DIAMOND DRILL & MFG. CO. **BIRDSBORO, PA.,** Builders of High Class Steam Engines. Diamond Drilling and General Machinery. Flour Mill Rolls Ground and Grooved.

THE GREAT TELESCOPES OF THE World.—A paper by Prof. John K. Rees, giving a popular account of all the great telescopes, their powers and limitations and method of construction. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **635.** Price 10 cents. To be had at this office and from all newsdealers.

THE CRANK'S STORY.—BY G. H. Edwards, C.E. The part played by the crank in developing the economy of steam in multiple cylinder engines. With two figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **641.** Price 10 cents. To be had at this office and from all newsdealers.

WORKING MODELS and Experimental Machinery, metal or wood, made to order by MASON & RAUCH, successors to J. F. Werner, 62 Centre Street, New York.

ERIE ENGINE WORKS WALNUT STREET ERIE PA MANUFACTURERS OF STATIONARY-PORTABLE-AGRICULTURAL ENGINES STATIONARY-PORTABLE-VERTICAL BOILERS

IRRIGATING MACHINERY ON THE Pacific Coast.—By John Richards. An elaborate discussion of the modifications that have had to be made in irrigating machinery to meet the requirements of local conditions in California. Contained in SCIENTIFIC AMERICAN SUPPLEMENT Nos. **624** and **625.** Price 10 cents each. To be had at this office and from all newsdealers.

Woodworking Machinery

FOR **Chair, Furniture and Cabinet Mills, Pattern Makers' use etc.**

Rollstone Machine Co., 48 Water Street, Fitchburg, Mass.

HOME-MADE INCUBATOR.—PRACTIcal directions for the manufacture of an effective incubator that has been carefully tested and found to perform all that may be reasonably expected; with directions for operating. With 4 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, NO. **630.** Price 10 cents. To be had at this office and from all newsdealers.

WIRE ROPE

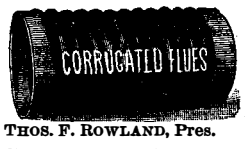
Address JOHN A. ROEBLING'S SONS, Manufacturers, Trenton, N. J., or 117 Liberty Street, New York.

Wheels and Rope for conveying power long distances. Send for circular.

THE CONTINENTAL IRON WORKS,

BROOKLYN, N. Y.,

SOLE MANUFACTURERS OF



CORRUGATED BOILER FLUES

Under their own patents and those of SAMSON FOX of Leeds, England.

MADE IN ALL SIZES, WITH FLANGED OR PLAIN ENDS.

☞ Take Ferry from 10th or 23d St., N. Y., to Greenpoint.

THOS. F. ROWLAND, Pres.

ICE and REFRIGERATING MACHINES

The Pictet Artificial Ice Company (Limited), Room 6, Coal & Iron Exchange, New York.

SYRACUSE MALLEABLE IRON WORKS

W. B. BURNS PROP'R

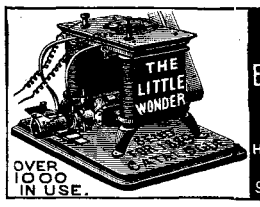
JAMES B. EADS.—AN ACCOUNT OF the life and labors of this eminent engineer. With a portrait. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **592.** Price 10 cents. To be had at this office and from all newsdealers.

USEFUL BOOKS.

Manufacturers, Agriculturists, Chemists, Engineers, Mechanics, Builders, men of leisure, and professional men, of all classes, need good books in the line of their respective callings. Our post office department permits the transmission of books through the mails at very small cost. A comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has recently been published for free circulation at the office of this paper. Subjects classified with names of author. Persons desiring a copy, have only to ask for it, and it will be mailed to them. Address,

MUNN & CO., 361 Broadway, New York.

SEVERN AND MERSEY TUNNELS.—Full description of these two important engineering works, with two engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. **604.** Price 10 cents. To be had at this office and from all newsdealers.



NICKEL AND ELECTRO-PLATING APPARATUS AND MATERIAL HANSON, VAN WINKLE & CO NEWARK, N.J. 92 LIBERTY ST. N.Y.

THE Scientific American

ESTABLISHED 1846.

The Most Popular Scientific Paper in the World.

Only $3.00 a Year, including Postage. Weekly. 52 Numbers a Year.

This widely circulated and splendidly illustrated paper is published weekly. Every number contains sixteen pages of useful information and a large number of original engravings of new inventions and discoveries, representing Engineering Works, Steam Machinery, New Inventions, Novelties in Mechanics, Manufactures, Chemistry, Electricity, Telegraphy, Photography, Architecture, Agriculture, Horticulture, Natural History, etc. Complete List of Patents each week.

Terms of Subscription.—One copy of the SCIENTIFIC AMERICAN will be sent for *one year*—52 numbers—postage prepaid, to any subscriber in the United States or Canada, on receipt of **three dollars** by the publishers; six months, $1.50; three months, $1.00.

Clubs.—Special rates for several names, and to Post Masters. Write for particulars.

The safest way to remit is by Postal Order, Draft, or Express Money Order. Money carefully placed inside of envelopes, securely sealed, and correctly addressed, seldom goes astray, but is at the sender's risk. Address all letters and make all orders, drafts, etc., payable to

MUNN & CO.,
361 Broadway, New York.

THE Scientific American Supplement.

This is a separate and distinct publication from THE SCIENTIFIC AMERICAN, but is uniform therewith in size, every number containing sixteen large pages full of engravings, many of which are taken from foreign papers, and accompanied with translated descriptions. THE SCIENTIFIC AMERICAN SUPPLEMENT is published weekly, and includes a very wide range of contents. It presents the most recent papers by eminent writers in all the principal departments of Science and the Useful Arts, embracing Biology, Geology, Mineralogy, Natural History, Geography, Archæology, Astronomy, Chemistry, Electricity, Light, Heat, Mechanical Engineering, Steam and Railway Engineering, Mining, Ship Building, Marine Engineering, Photography, Technology, Manufacturing Industries, Sanitary Engineering, Agriculture, Horticulture, Domestic Economy, Biography, Medicine, etc. A vast amount of fresh and valuable information obtainable in no other publication.

The most important Engineering Works, Mechanisms, and Manufactures at home and abroad are illustrated and described in the SUPPLEMENT.

Price for the SUPPLEMENT for the United States and Canada, $5.00 a year, or one copy of the SCIENTIFIC AMERICAN and one copy of the SUPPLEMENT, both mailed for one year for $7.00. Single copies 10 cents. Address and remit by postal order, express money order, or check,

MUNN & Co., 361 Broadway, N. Y.,
Publishers SCIENTIFIC AMERICAN.

Building Edition.

THE SCIENTIFIC AMERICAN ARCHITECTS' AND BUILDERS' EDITION is issued monthly. $2.50 a year. Single copies, 25 cents. Forty large quarto pages, equal to about two hundred ordinary book pages; forming a large and splendid **Magazine of Architecture,** richly adorned with *elegant plates in colors*, and with other fine engravings; illustrating the most interesting examples of modern Architectural Construction and allied subjects.

A special feature is the presentation in each number of a variety of the latest and best plans for private residences, city and country, including those of very moderate cost as well as the more expensive. Drawings in perspective and in color are given, together with full Plans, Specifications, Sheets of Details, Estimates, etc.

The elegance and cheapness of this magnificent work have won for it the **Largest Circulation** of any Architectural publication in the world. Sold by all newsdealers. $2.50 a year. Remit to

MUNN & CO., Publishers,
361 Broadway, New York.

PRINTING INKS.

THE "Scientific American" is printed with CHAS. ENEU JOHNSON & CO.'S INK. Tenth and Lombard Sts., Phila., and 47 Rose St., opp. Duane St., N. Y.

© 1889 SCIENTIFIC AMERICAN, INC